



PART IX. DESCRIPTION OF THE ENVIRONMENT,  
SUMMARY, MAPS.

Fasc. 1. DESCRIPTION OF THE ENVIRONMENT. By P. A. Buxton.

*Pp. 1-32 : 6 pls., 2 text-fig. Issued 22nd November, 1930.*

„ 2. SUMMARY. By P. A. Buxton.

*Pp. 33-104. Issued 8th June, 1935.*

„ 3. ADDENDA.

CORRIGENDA.

INDEX.

*Pp. 105-159. Issued 20th December, 1935.*

MAPS.

(Subsequently reprinted in Part IX, Fasc. 1)

No. 1. SOUTH WEST PACIFIC.

No. 2. SAMOAN ISLANDS.

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*Dept. of Entomology,  
Keper's Study.  
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BRITISH MUSEUM (NATURAL HISTORY)

INSECTS OF SAMOA  
AND OTHER SAMOAN TERRESTRIAL  
ARTHROPODA

PART VII. OTHER ORDERS OF INSECTS

FASC. 1. Pp. 1-44.

ISOPTERA: Family TERMITIDAE

By GERALD F. HILL

NATIONAL MUSEUM, MELBOURNE

AND

ODONATA

By LT.-COL. F. C. FRASER, I.M.S., F.E.S.

WITH NINETEEN TEXT-FIGURES AND ONE PLATE



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# INSECTS OF SAMOA

## AND OTHER SAMOAN TERRESTRIAL ARTHROPODA

Although a monograph, or series of papers, dealing comprehensively with the land arthropod fauna of any group of islands in the South Pacific may be expected to yield valuable results, in connection with distribution, modification due to isolation, and other problems, no such work is at present in existence. In order in some measure to remedy this deficiency, and in view of benefits directly accruing to the National Collections, the Trustees of the British Museum have undertaken the publication of an account of the Insects and other Terrestrial Arthropoda collected in the Samoan Islands, in 1924-1925, by Dr. P. A. Buxton and Mr. G. H. E. Hopkins, during the Expedition of the London School of Hygiene and Tropical Medicine to the South Pacific. Advantage has been taken of the opportunity thus afforded, to make the studies as complete as possible by including in them all Samoan material of the groups concerned in both the British Museum (Natural History), and (by courtesy of the authorities of that institution) the Bishop Museum, Honolulu.

It is not intended that contributors to the text shall be confined to the Museum Staff or to any one nation, but, so far as possible, the assistance of the leading authorities on all groups to be dealt with has been obtained.

The work will be divided into eight "Parts" (see p. 3 of wrapper), which will be subdivided into "Fascicles." Each of the latter, which will appear as ready in any order, will consist of one or more contributions. On the completion of the work it is intended to issue a general survey, summarising the whole and drawing from it such conclusions as may be warranted.

BRITISH MUSEUM (NATURAL HISTORY),  
CROMWELL ROAD, S.W.7.





# INSECTS OF SAMOA

PART VII. FASC. 1

ISOPTERA

Family : TERMITIDAE

BY GERALD F. HILL, National Museum, Melbourne

(With 14 Text-figures, and 1 Plate)

IN December 1925, Dr. P. A. Buxton very kindly sent me for examination a collection of Termites made by him and his assistant, Mr. G. H. E. Hopkins, during their sojourn in the Samoan Islands. I am greatly indebted to Dr. Buxton for the privilege of working out this very interesting collection, to Mr. J. A. Kershaw for facilities provided at the National Museum, and to Mr. C. A. Lambert for courteously preparing the photomicrographs.

The types and other specimens are in the British Museum (Natural History); para-types are in the National Museum, Melbourne, and in my own collection.

## HISTORICAL

The first published record of Termites in the South Sea Islands appears to be that of Rainbow (1897), who recorded *Calotermes marginipennis* Latr., from the island of Funafuti, Ellice Group. In 1905 Desneux described eight species and one sub-species from German New Guinea. Four years later Silvestri (1909) described two species from the Samoan Islands. Six new species and one species previously known to occur in Borneo were recorded from German New Guinea by Holmgren in 1911, and in the following year the same writer described a new species from Samoa. The descriptions of eight species from New Hebrides, New Caledonia and Loyalty Islands, by N. and K. Holmgren, followed in 1915. In 1925 Snyder published a paper on the Termites of the Solomon Islands and Santa Cruz Archipelago, in which thirteen species



and one variety were described as new; and later in the same year I described two species from Lord Howe Island. In three papers now in course of publication (Hill, Memoirs of National Museum, Melbourne, No. 7, and Proc. Roy. Soc. Vic., xxxviii.), thirteen species are described from New Guinea, New Britain, New Ireland, New Hebrides and Solomon Islands, the species misidentified as *Calotermes marginipennis* Latr., by Rainbow, is described as new, and two species are described from Fiji. Amongst the proposed new species from the Solomon Islands are two which may prove to be synonymous with forms described by Snyder.

#### SAMOAN TERMITES

Only three species of Termites have been recorded previously from the Samoan Islands, namely, *Calotermes samoanus* Holmgr., *Protrichotermes inopinatus* Silv., and *Microcerotermes peraffinis* Silv., Dr. Buxton's collection contains complete series of each of these, and, in addition, four species of the genus *Calotermes*, of which number two are described here as new, one is referred to a recently described species known hitherto only in the alate form, and one is considered to be specifically indeterminable.

##### 1. *Calotermes* (*Neotermes*) *samoanus* Holmgren.

Entom. Mitteilungen, Deutschen Entom. Mus., Bd. i, No. 9, 1912.

Text-figs. 1-4; Plate 1, figs. 1, 2.

This species was described from an imperfect imago from Apia, Samoa; the soldier has not been described previously.

##### IMAGO (*redescribed*)

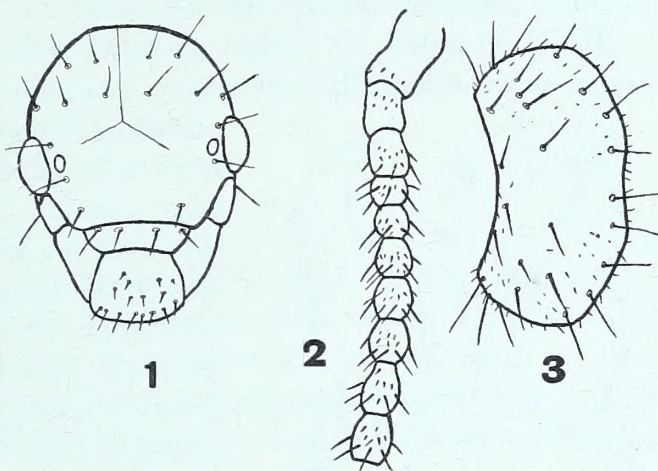
*Colour*.—Head light chestnut, darker than *C. sanctaecrucis* Sny. ("light castaneous (reddish-brown)"), darker than *C. rainbowsi* Hill; thorax and abdomen slightly darker than head; wing-stumps darker than thorax; wings cinnamon-brown, darker than those of last-mentioned species, veins darker than membrane.

*Head* (Text-fig. 1).—Longer than wide, glabrous, with a few long setae; frons flat, with obscure depressions. Eyes sub-triangular, diam.  $0.51 \times 0.51$ – $0.54 \times 0.54$ , prominent,  $0.35$ – $0.40$  from lower margin of head. Ocelli very close to eyes, broadly oval, long diameter about one-third that of eye. Clypeus stramineous, wide, a little less than four times wider than long, truncate in front,



with two pairs of moderately long setae. Labrum a little wider than long ( $0.68 \times 0.51$ ), markedly rounded on sides and convex above, rounded at apex where there are a few short setae. Antennae (Text-fig. 2) 18-jointed; 3rd segment about as long as 2nd, but narrower at base and darker in colour; 4th–6th globular, narrower than 3rd; 7th–16th increasing in length progressively.

*Thorax* (Text-fig. 3; Pl. 1, fig. 1).—With a few very long and numerous minute setae, wider than head, strongly concave in front, widest across the middle sides rounded and with faintly impressed margin, posterior margin sinuate.



*Calotermes (N.) samoanus*. TEXT-FIG. 1.—Head of imago.  
TEXT-FIG. 2.—Antenna of imago. TEXT-FIG. 3.—Pronotum of imago.

*Wings* (Pl. 1, fig. 2).—Wing-stumps with very few and very short setae. Forewing with four branches from the radial sector to costa, the median vein typical of sub-genus, the cubitus passing through the middle of wing to near its extremity where it bends down to join the border a little below the apex of wing, with nine or ten inferior branches. In the hindwing the median vein branches from the radial sector at about the proximal fifth of wing; the cubitus passes through the middle of wing and has seven or eight branches. Anal veins distinct in hindwings, obscure or wanting in forewings.

*Legs*.—Yellowish-brown, tibiae darker, clothed with scanty long and short setae; tibial spurs 3 : 3 : 3, long and slender.

*Abdomen*.—With setae as on pronotum; styli present in male, very small.

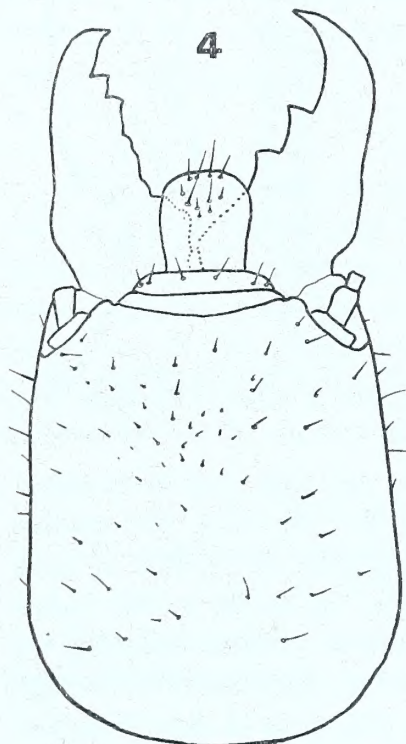
Measurements.	mm.
Length with wings . . . . .	18.00
Length without wings . . . . .	8.50–9.00
Head, to apex of labrum, long . . . . .	2.40
Head, to clypeofrontal suture, long . . . . .	1.76
Head, at and including eyes, wide . . . . .	1.76–1.82
Pronotum, long 1.19–1.42; wide . . . . .	2.05–2.28
Forewing, long 13.00; wide . . . . .	4.40
Tibia iii, long . . . . .	1.50–1.60



## SOLDIER

*Colour*.—Head chestnut, mandibles black (sometimes castaneous at base), pronotum buckthorn-brown, legs clay-colour.

*Head*.—(Text-fig. 4). Large, generally widest in middle, but sometimes parallel on the sides, with very scanty, moderately long setae. Antennae long, extending beyond apex of mandibles, 15- to 18-jointed, generally 17-jointed; variable in segmentation; 3rd segment distinctly longer than 2nd and 4th, subclavate, or equal to, or very little longer than, 4th; 3rd and 4th sometimes sub-equal and distinctly shorter than 2nd; 5th–12th increasing in length progressively; 13th to penultimate segments about as long as 12th, the apical segment shorter and narrower than the penultimate. Left mandible with two large angular teeth in the apical third, followed by a large double tooth slightly in advance of the apex of the labrum, the right with two very large teeth about the middle, the hindermost in line with the apex of labrum. Labrum large, rounded at apex where there is a group of about six large setae. Clypeus without conspicuous setae. Gula long and narrow, nearly parallel on the sides.



TEXT-FIG. 4. *Calotermes (N.) samoanus*.—Head of soldier.

*Thorax*.—Pronotum large, not as wide as head, strongly concave in front, rounded on sides and very nearly straight behind, with very scanty long setae and scarcely more very short ones, the margin impressed.

*Legs*.—Moderately long and stout, with only a few long setae on femora, more numerous and interspersed with short ones on tibiae; tibial spurs 3 : 3 : 3, moderately long and stout.

*Abdomen*.—Clothed similarly to pronotum; cerci and styli small.



Measurements.	mm.
Total length . . . . .	12.00-13.00
Head, with mandibles, long . . . . .	4.90- 6.00
Head, without mandibles, long . . . . .	3.13- 4.00
Head, wide . . . . .	2.75- 3.13
Head, deep . . . . .	2.00- 2.28
Gula, at narrowest part, wide . . . . .	0.28- 0.39
Pronotum, long, max. 1.42-1.70; min.* . . . .	1.19- 1.53
Pronotum, wide . . . . .	2.45- 3.00
Tibia iii, long . . . . .	1.80- 2.20

*Locality*.—Samoan Islands: Malololelei, Upolu Is., 2,000 ft., soldiers, imagos and nymphs, 20.6.24, type colony for soldier; same locality, soldiers and nymphs, 23.2.24 (No. 623), from galleries in rotten wood; Mt. Vaea, Upolu Is., soldiers and nymphs, 17.10.25, in rotten log; Vailima, Upolu Is., alate imago, 7.10.25; same locality, soldiers and nymphs (No. 682), June 1924, from rotten log; same locality, "first-form" king and queen, 8.6.24, from rotten wood.

*Allied species*.—The imago is very similar to *C. rainbowi* Hill, but it is darker in colour and has much longer and more numerous setae on pronotum and abdomen. The soldier differs from *C. rainbowi* in having darker and wider head, narrower gula and relatively shorter pronotum. From *C. sanctae-crucis* Sny., the imago differs in its smaller size, much smaller pronotum, smaller head, eyes and ocelli and two or three joints less in antennae. Both species have scattered large setae on head, thorax and abdomen, but they are fewest and largest on Snyder's species. From the New Britain species which I have described and provisionally referred to *C. papua* Desneux (Hill, Mem. Nat. Mus. Melb., No. 7, 1926), the imago differs in being a little larger, antennal joints larger and darker, and head larger and less setaceous. In the soldier caste the Samoan species differs from the New Britain insect in having a darker, more rounded and more setaceous head, differently sculptured frons, and much more setaceous pronotum and abdomen. The imago of *C. sanctae-crucis* is distinguished from *C. rainbowi* by its larger size, larger eyes and ocelli, larger setae on head, thorax and abdomen, and much larger pronotum.

A fungus found growing on the fore-leg of termites of this species will be described and figured by Mr. P. C. Tate, in a forthcoming part of *Parasitology*.

\* *I.e.* measured in median line. See Light, Philippine Jr. Sc., xix. (1), p. 29, July 1921.



2. *Calotermes (Calotermes) repandus* Hill.

"Entomologist," vol. 59, p. 297, 1926.

Text-figs. 5-9; Plate 1, figs. 3, 4.

## IMAGO

*Colour*.—Head, thorax and basal segments of abdomen light brown (Sandford's brown); wing-stumps and apical segments of abdomen darker (hazel); labrum, antennae and tibiae clay-colour; wings hyaline, veins cinnamon-brown.

*Head* (Text-fig. 5).—With scanty long setae, broadly rounded behind, narrowed to the base of mandibles, frons with a distinct depression on either side of the middle. Clypeus large, anterior half whitish and slightly concave anteriorly. Labrum strongly convex, slightly widened on the sides, broadly rounded at apex. Eyes sub-triangular, large ( $0.46 \times 0.46$ ), very prominent, 0.25 from lower margin of head. Ocelli large ( $0.136 \times 0.170$ ), prominent, very close to eyes. Antennae 17- to 18-jointed; 3rd segment about as long as 2nd, a little darker and narrower at base; 4th much shorter than 3rd, very little shorter and narrower than 5th; 6th-16th or 17th increasing in length progressively; apical segment as long as, but narrower than, preceding one.

*Thorax* (Text-fig. 6; Pl. 1, fig. 3).—Pronotum very large, wider than head, deeply concave in front, sides nearly straight, posterior margin broadly rounded and slightly concave in the middle, margins impressed, with scanty short setae; posterior margin of meso- and metanotum as in pronotum.

*Wings* (Pl. 1, fig. 4).—Wing-stumps glabrous, with very few and very short setae; stumps of forewings large, nearly covering those of hindwings, apex markedly convex in forewings, only slightly convex in hindwings. Venation variable; in forewings the sub-costa is short, about one-third as long as radius; radius joining costa about the middle of wing; radial sector with about six branches, the first joining the radius before the latter joins the costa; median vein in typical position for the sub-genus, distinct only at the base; cubitus with only about six of the proximal branches discernible. Hindwing with sub-costa not extending beyond suture; radius joining costa beyond the middle of wing; radial sector with four or five branches, the first commencing a little before the junction of the radius with the costa; median vein branching from the radial sector close to base of wing, very indistinct at base, then becoming gradually indiscernible as it passes through the middle of the wing; cubitus as in forewing.



*Legs*.—Short and moderately stout, with few setae; tibial spurs 3:3:3, small.

*Abdomen*.—Glabrous, very little widened about the middle, tergites with scanty apical fringe of moderately short and very short setae and a scantier row about the middle; styli (male) very small; seventh sternite of female not much longer than sixth.

Measurements.	mm.
Length with wings . . . . .	15.00
Length without wings . . . . .	8.00–8.50
Head, to apex of labrum, long . . . . .	2.00
Head, to clypeofrontal suture, long . . . . .	1.42
Head, wide . . . . .	1.62
Pronotum, long 1.19–1.31; wide . . . . .	1.82
Forewings, long 11.5; wide . . . . .	3.13
Hindwings, long 11.0; wide . . . . .	3.19
Tibia iii, long . . . . .	1.33

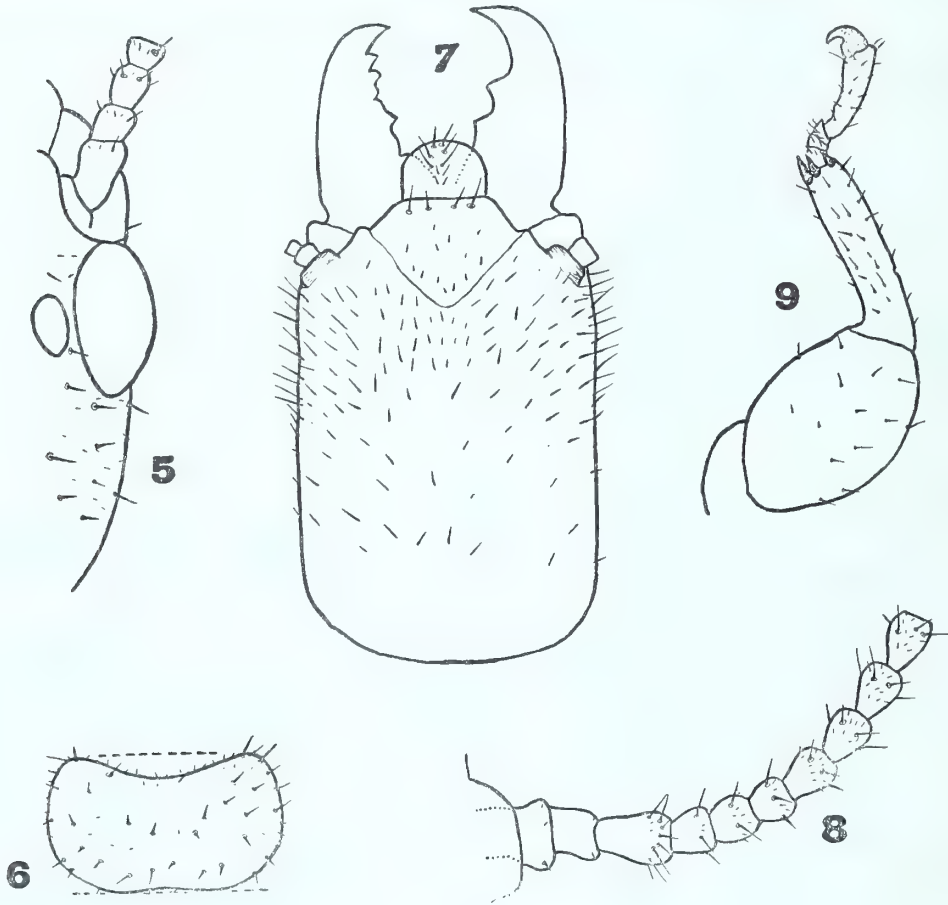
#### SOLDIER

*Colour*.—Head burnt sienna, labrum and antennae ochraceous-tawny, anteclypeus hyaline, mandibles black (dark castaneous at base), pronotum, legs and abdomen clay-colour.

*Head* (Text-fig. 7).—With rather numerous setae on posterior half, distinctly more numerous on frons and behind antennal foveolae, sides parallel, posterior margin broadly rounded, frons slightly concave and obscurely sculptured; viewed from the side the head is shallow and the mandibles distinctly bent upwards. Labrum short and wide, broadly rounded in front, the margins impressed, a group of setae near its apex. Mandibles very stout, with two short teeth about the middle on the right, the hindermost nearly or quite concealed by the labrum, the left with two teeth near the apex and a large single tooth opposite the angle between the two teeth on the right. Gula long and rather wide, hardly widened posteriorly. Antennae (Text-fig. 8) 13- to 15-jointed; 1st short and stout, much swollen apically, nearly hidden from above by antennal carina; 2nd very short, nearly quadrate; 3rd nearly twice as long as 2nd, dark in colour, clavate; 4th about as long as 2nd and narrower; 4th–10th increasing in length and becoming progressively narrower at base; 11th–14th elongate, about as long as 10th; apical segment shorter and narrower than one preceding it. In a few examples the antennal joints are relatively shorter and stouter than in the majority.



*Thorax*.—Pronotum very little wider than head, with few setae, anterior margin deeply and obtusely notched, the sides at first slightly and then more sharply narrowed to the narrow and faintly sinuate posterior margin. Posterior



TEXT-FIG. 5. *Calotermes (C.) repandus*.—Side of head, showing eye, ocellus and basal segments of antenna of imago. TEXT-FIG. 6.—Pronotum of imago. TEXT-FIG. 7.—Head of soldier. TEXT-FIG. 8.—Antenna of soldier. TEXT-FIG. 9.—Hind leg of soldier.

margin of meso- and metanotum as in pronotum or with slightly prolonged posterolateral corners.

*Legs* (Text-fig. 9).—Very short and stout, with a few long setae; claws large; tibial spurs short, stout, finely serrated, 3 : 3 : 3.

*Abdomen*.—Long and narrow, with very few setae, these mostly arranged as a fringe of long and short ones at apex of segments and in a scantier row about the middle.



Measurements.	mm.
Total length . . . . .	10.00–13.50
Head, with mandibles, long . . . . .	3.85– 5.15
Head, without mandibles, long . . . . .	2.50– 3.60
Head, wide . . . . .	1.70– 2.33
Head, deep . . . . .	1.25– 1.70
Gula, at narrowest part, wide . . . . .	0.28– 0.50
Antenna, long . . . . .	2.28
Pronotum, long (max.) 1.08–1.70 ; wide . . . . .	1.75– 2.45
Tibia iii, long . . . . .	0.96– 1.36

The pronotum length recorded above is the distance between imaginary lines as shown in Text-fig. 6, *i.e.* the maximum length ; the actual length of the sclerite taken in the median line is only 0.90–1.50. In all my earlier papers I have recorded the maximum length only.

*Locality*.—Samoa Islands : Apia, Upolu Is., alate imago (type), 6.4.25 ; same locality, alate imago, 1.5.25 ; same locality, alate imago, August 1925 ; same locality, deälated male and female, February 1925, in rotten Anona tree ; same locality and month, queen, two soldiers and two nymphs, in rotten tree ; Mulifanua, Upolu Is., two soldiers ; Aleipata, Upolu Is., soldiers, nymphs and larvae (No. 639), 7.4.24, in large forest tree in which was found also a colony of *Prorhinotermes inopinatus* Silv. Also recorded from Fiji (Hill, Proc. Roy. Soc. Vic., in Press).

### 3. *Calotermes* (*Cryptotermes*) *buxtoni* Hill.

“Entomologist,” vol. 59, p. 298, 1926.

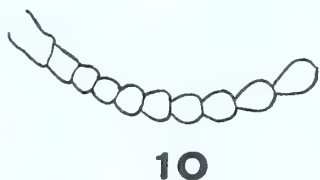
Text-figs. 10–14.

#### IMAGO

There appears to be no reliable character by which the imago of this species can be distinguished from *Cryptotermes primus* Hill (from Townsville, N. Queensland), which is described in Proc. Linn. Soc. N. S. Wales, xlv. (4), p. 446, 1921. The eyes appear to be always larger in the Queensland species, but there is very little difference between the largest in the one and the smallest in the other. The antennae (Text-fig. 10) are 16-jointed ; 2nd segment stout, nearly as wide and about two-thirds as long as 1st ; 3rd variable, shortest and narrowest of all or a little longer than 4th ; 4th–15th increasing in length progressively ; 16th elongate-oval, shorter and narrower than 15th. Wings hyaline with light brown costa, sub-costa, radius and radial sector, a few setae



on wing-stumps and on costa as far as extremity of radial sector, none elsewhere; membrane with many scale-like micrasters; sub-costa of forewing very short, sometimes fused with costa at or a little beyond suture; radius short, joining costa a little beyond first branch of radial sector; radial sector with from five to seven branches to the costa, the first long, the others decreasing in length progressively, all very distinct to their termination; media obscure, joining radial sector at about the anterior one-third of wing, not thickened at its extremity; cubitus with about twelve branches, these nearly always simple, the main stem passing through the middle of wing to about the apical third,



10

TEXT-FIG. 10. *Calotermes (C.) buxtoni*.—Basal segments of antenna of imago.



11

TEXT-FIG. 11.—*Calotermes (C.) buxtoni*.  
Mandibles of imago.

then rising slightly before descending to its junction with the wing margin just below the apex of the wing. Hindwing with four to seven branches from the radial sector; media shorter than that of forewing, branching from radial sector near the suture and rejoining it a little beyond middle of wing, its extremity not thickened; cubitus passing through middle of wing to a point opposite termination of media, then rising to the anterior third before descending to its termination just below apex of wing. Mandibles and pronotum as in Text-figs. 11 and 12.

Measurements.	mm.
Length with wings . . . . .	9.75–10.00
Length without wings . . . . .	6.25
Head, to apex of labrum, long . . . . .	1.30
Head, to clypeofrontal suture, long . . . . .	1.00
Head, wide . . . . .	0.97
Eyes, diam. . . . .	0.23 × 0.30–0.28 × 0.32
Pronotum, long 0.62–0.68; wide . . . . .	0.91– 1.12
Forewing, long 7.00–7.25; wide . . . . .	1.95
Tibia iii, long . . . . .	0.55

#### SOLDIER

*Colour*.—Head and mandibles black, the former shading to dark castaneous at base.

*Head* (Text-figs. 13, 14).—Finely shagreened, short and wide, widest at



anterior fourth, slightly narrowed to the broadly rounded posterior margin, with scanty minute setae, anterodorsal margin (frontal flange) convex, projecting well over frons, deeply and narrowly incised in middle, frons deeply excavated and vertical, the horn-like prolongation of lower lateral margin of head long and stout, directed upwards at same angle as mandibles, the latter short, stout and markedly bent upwards. Labrum pale, widest at base, narrowed to the bluntly pointed apex. Antennae 13-jointed, very short.

*Thorax*.—Pronotum (Text-fig. 14) nearly as long as wide, as wide as head, the anterior margin thickened, bent up, obtusely notched in middle, anterolateral angles wide and markedly elevated, sides and posterior margin rounded, the latter slightly concave in the middle, entire margin fringed with scanty, very small setae. Posterior margin of meso- and metanotum as in pronotum.

*Legs*.—Short and stout, with few setae; tibial spurs 3 : 3 : 3, serrate.

*Abdomen*.—Short, wide in the middle and sharply tapered to the pointed apex, apex of segments with scanty fringe of setae somewhat longer than those on thorax.

Measurements.	mm.
Total length (head bent at angle 45°) . . . . .	4.00
Head, from base to frontal flange, long . . . . .	1.17
Head, to apex of mandibles, long . . . . .	1.70
Head, wide . . . . .	1.25
Head, deep . . . . .	1.08
Pronotum, long 1.20; wide . . . . .	1.25
Tibia iii, long . . . . .	0.75

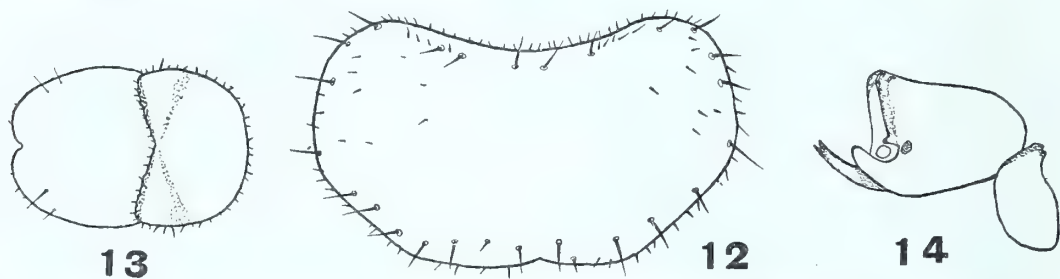
*Locality*.—Samoan Islands : Apia, Upolu Is., 10.12.24.

Described from a small colony comprising several alate imagos, one soldier and many nymphs and larvae, found in galleries in a chair. The collection contains another imago from same locality, taken at light in March. Buxton informs me that this is the only case of damage to furniture, by this or any other species of Termite, which came to the knowledge of himself or Mr. Hopkins during two years in Samoa; no damage to the structure of houses was observed, and none of damage to trees or crops. The highly indigenous Termite fauna of Samoa appears to be at present harmless.

*Allied species*.—The following additional comparisons with previously described species may be noted: The imago is also very similar to *C. arcanus* Hill (Proc. Roy. Soc. Vic., xxxvii (2), p. 214, 1925), from which it appears to differ chiefly in its lighter coloured head, body and wings. The soldiers of *C.*



*primus* and *C. arcanus* are quite distinct from each other and from *C. buxtoni*. From *C. primus* the latter differs markedly in having a larger and more rounded head, anterodorsal margin of head (frontal flange) as seen from above strongly convex and deeply incised in the middle (not straight and without deep median incision), and projecting beyond vertical frons as seen in profile, shorter and more upturned mandibles and distinctly different shaped pronotum. From *C. arcanus* (from Lord Howe Is.) it differs in its larger size, vertical frons, mandibles shorter and markedly bent upwards (not nearly parallel with axis of head), frontal flange when viewed diagonally from behind convex and deeply incised in the middle (not concave and without median incision), pronotum larger, with anterolateral corners larger and distinctly more elevated. From *C. secundus* Hill (Proc. Roy. Soc. Vic., xxxvii. (2), 215), it differs as above in



*Calotermes (C.) buxtoni*. TEXT-FIG. 12.—Pronotum of imago. TEXT-FIG. 13.—Head and pronotum of soldier, viewed obliquely from behind. TEXT-FIG. 14.—Head and pronotum of soldier in profile.

most of the features enumerated, but especially in the form of the frontal flange. From *C. gulosus* Hill (Mem. Nat. Mus., Melb., No. 7, in Press), the imago differs chiefly in its smaller eyes and pronotum. From the soldier of *C. gulosus* it differs in its larger size, frontal flange as viewed from above much more deeply incised in the middle and differently sculptured, and, viewed laterally, projecting further over the frons, pronotum larger and of different shape. From the imago of *C. torresi* Hill (MS), it differs in its lighter colour and larger size, distinctly larger head, larger eyes and longer pronotum. In the soldier caste it differs from this Thursday Is. species in having the median incision in the frontal flange much deeper and narrower and connected with a rather large and deep impression in the upper part of the frons (in *C. torresi* there are two smaller impressions, one on each side of the median line, in this position), the pronotum larger and with anterolateral corners more bent up and the anterior margin much more widely and a little more obtusely emarginate. The imago



differs from *C. hermsi* Kirby (from Fanning Is.) in having smaller and less prominent eyes, the facets larger and the pronotum less setaceous. The soldier differs in its slightly larger size, the frontal flange projecting further over the frons, the median incision very much deeper and extending into the frons (in *C. hermsi* it is obscure when viewed obliquely from behind and does not extend into the frons), and the horn-like projection on either side of the frons stouter. From *C. repentinus* Hill (Mem. Nat. Mus., Melb., No. 7), from New Britain, it is distinguished by its larger size, longer and paler wings, etc. Authenticated specimens of the following additional species have been compared with the present species :—*C. brevis* Walk., *C. thompsoni* Sny., *C. cyanocephalus* Light, *C. nocens* Light, and *C. cavifrons* Banks.

#### 4. *Calotermes* (*Cryptotermes*), spp.

Two alate imagos from Pago Pago, Tutuila Is., Samoan Islands, 12.8.25, are intermediate in size between *C. buxtoni* and the species referred to in the following paragraph ; they may represent a distinct species, but this cannot be determined until a complete series is available for examination.

The collection contains also a single alate imago from Neiafu, Vavau Is., Tonga Group (March 1925), which appears to be specifically distinct from previously described species. It is considerably smaller than *C. buxtoni*, from which it differs also in having slightly larger eyes, smaller and more quadrate pronotum and relatively longer and narrower head. A closely related form has been collected recently by Mr. A. M. Lea in Fiji.

#### 5. *Calotermes* (*Clyptotermes*) *xantholabrum* Hill.

Mem. Nat. Mus., Melb., No. 7 (In Press).

This species was described from two alate imagos from Rabaul, New Britain ; the soldier has not been described hitherto. The imagos in the several series referred to below agree with the type, whilst the nymphs and larvae associated with them agree with those associated with the two soldiers from Apia. On this evidence of conspecificity one of the soldiers has been selected as morphotype, and is described here. For several reasons the selection of such a specimen as secondary type is open to objection, but as no difference can be detected between the New Britain and Samoan imagos, and as there is very

little probability of the imagos and soldiers from the latter locality being otherwise than conspecific, it seems advisable to follow this course. It is quite possible, however, that in this sub-genus, as in *Cryptotermes*, there are species with markedly different soldiers which cannot be differentiated satisfactorily in the alate caste.

#### SOLDIER

*Colour*.—Head burnt sienna, antennae and legs a little lighter, mandibles dark castaneous with black tips, remainder of insect tawny.

*Head*.—Finely shagreened, with very few moderately long reddish setae, almost parallel on sides, broadly rounded behind, frons broadly and deeply concave, but without frontal flange, sloping at an angle of  $45^{\circ}$  to axis of head. Clypeus shagreened, large, slightly arcuate in front, with a transverse row of minute setae about the middle. Labrum shagreened, large, a little wider than long, wide at base, slightly swollen on sides and broadly rounded in front, apex barely covering second tooth on left mandible, the entire margin narrowly impressed, a group of about twelve relatively large setae near apex. Antennae very short, extending little beyond apex of mandibles; 10-jointed, 1st segment short and stout; 2nd about two-thirds as long as 1st and one-fourth narrower; 3rd very short and narrow, widest apically and closely fused with 4th; 5th about as long as 2nd, but much wider; 6th–8th globular; 9th a little longer than wide; 10th about as long as 9th, but much narrower. Mandibles short and stout; the left with two short teeth on the apical half and another about the middle; the right with two short stout teeth about the middle, the angle between them opposite the apex of hindermost tooth on left; other teeth, if present, cannot be demonstrated without dissection. Gula short and wide. Intersegmental membrane surrounding cervical sclerites whitish and markedly shagreened.

*Thorax*.—Pronotum very little narrower than head, short, with scanty short and long setae and narrowly impressed margin, anterior margin concave, anterolateral angles very little rounded, sides sloping to the broadly rounded posterior margin. Posterior margin of meso- and metanotum slightly sinuate.

*Legs*.—Short and stout, with few setae; claws and tibial spurs large, the latter serrate, 3 : 3 : 3.

*Abdomen*.—Long and narrow, widest in middle, tapered thence to the bluntly pointed apex; apex of segments with scanty fringe of long and very short setae. Cerci and styli moderately large.



Measurements.	mm.
Total length . . . . .	5.00-6.00
Head, with mandibles, long . . . . .	1.60-1.70
Head, without mandibles, long . . . . .	1.17
Head, wide . . . . .	0.85
Head, deep . . . . .	0.77
Gula, at narrowest part, wide . . . . .	0.22
Pronotum, long 0.40-0.45 ; wide . . . . .	0.76-0.82
Tibia iii, long . . . . .	0.47

*Locality*.—Samoan Islands : Malololelei, Upolu Is., 2,000 ft., several imagos and nymphs, 21.6.24 ; same locality larvae and nymphs, 18.4.25 ; same locality, one deälated imago, 3.6.24 ; Apia, Upolu Is., two soldiers and several larvae and nymphs (No. 633) in rotten wood, 27.3.24 (Type colony for soldier) ; same locality, one alate imago, 4.7.24 ; same locality, ten imagos (mostly immature) and several larvae and nymphs (No. 603), in rotten log, 31.1.24.

A Gamasid Mite which was found adhering by its anus to the antennae of this species of Termite, in Apia, will be described by Mr. A. S. Hirst in Part VIII of this work.

## 6. *Prorhinotermes inopinatus* Silvestri.

Die Fauna Südwest-Australiens, Isoptera, ii. (17), 1909.

This species is represented in the Buxton and Hopkins collection by six colonies, as follows :—

Three colonies of soldiers and workers from Vailima, Upolu Is., from April to June 1924 ; in rotten wood.

Numerous soldiers, brachypterous kings and queens, workers and larvae from Malololelei, Upolu Is., 23.2.24 ; in rotten post.

Alate imagos, soldiers and workers from Nuutele Is., 9.4.24.

Deälated imagos, soldiers and workers from Apia, Upolu Is., 10.7.24 ; in rotten Kapok stump.

Numerous apterous and brachypterous kings and queens, soldiers, workers and larvae (No. 760) from Apia, May 1925 ; from paper stored on floor.

In addition to the above, the following specimens in the collection of the Bishop Museum have been examined ; from Amauli, Tutuila Island, nest on coconut palm (Swezey and Wilder) ; from Pago Pago, Tutuila Island (Bryan) ; several specimens from Apia, Upolu Island.

The apterous reproductive form has lightly chitinized body, as in soldier. 16- to 19-jointed antennae, small unpigmented eyes, no ocelli and lateral and posterolateral margins of meso- and metanotum slightly thickened and expanded. The brachypterous form is much more heavily chitinized, and has 17- to 19-jointed antennae, large eyes without or with slight pigmentation, eye facets developed, ocelli present, lateral and posterolateral margins of meso- and metanotum broadly expanded so as to leave the posterior margin deeply and narrowly notched in the middle, as figured by Silvestri.

The soldier is described as having 17-jointed antennae ; the number ranges from 17 to 20 in series collected by Dr. Buxton. There is also a considerable range of variation in the shape and size of the head and in the body length of individuals from the same colony. The following measurements are from three selected specimens from the colony, collected in Apia in May :—

Measurements.	mm.
Total length . . . . .	3.76 ; 6.50 ; 7.00
Head, with mandibles, long . . . . .	2.00 ; 2.50 ; 2.67
Head, without mandibles, long . . . . .	1.20 ; 1.65 ; 1.76
Head, wide . . . . .	0.90 ; 1.36 ; 1.42
Pronotum, long . . . . .	0.40 ; 0.68 ; 0.68
Pronotum, wide . . . . .	0.68 ; 1.19 ; 1.25

## 7. *Microcerotermes peraffinis* Silvestri.

Die Fauna Südwest-Australiens, Isoptera, ii. (17), 1909.

The Buxton and Hopkins collection contains ten series from the Samoan Islands, as follows :—

Soldiers, workers and larvae (No. 634) from Apia, Upolu Is., March 1924 ; from termitarium on trunk of mango tree ; no Trichonymphids in a dozen workers and larvae examined by Dr. Buxton.

Soldiers, workers and larvae (No. 604) from Apia, 31.1.24 ; “ from carton nest in Cocos trunk ; nests generally 4 to 8 ft. up ; common all along coast on coconuts, mangoes, etc., and not commonly on uncultivated trees ; quite probably introduced.”

Alate imagos, workers and larvae from Apia, 2.3.24 ; from carton nest on mango trunk.

Soldiers, workers and larvae (No. 632) from same nest as No. 604 ; no Trichonymphids in six workers examined by Dr. Buxton.



Soldiers from Stevenson's Grave, Apia (1,000 ft.), 29.3.24.

Soldiers, workers and larvae from Apia, 6.1.24 ; in carton nest on top of mango stump.

Soldiers, workers and larvae (No. 637) from Aleipata, Upolu Is., 7.4.24 ; from small nest on coconut.

Alate imagos, seventeen brachypterous queens, first-form nymphs, workers and larvae (No. 638) from Aleipata, 7.4.24 ; " large flourishing colony on unknown tree ; nest fairly closely examined bit by bit, but no first-form sexual forms or royal cell found ; a nest on the next tree and connected with the first by galleries was hard and woody and contained many neoteinics and winged adults."

Soldiers, workers and larvae from Namua Is., 10.4.24.

Alate imagos, nymphs, soldiers, workers and larvae from Fagamalo, Savaii Is., 2.8.24.

In addition to the above, the following material in the Bishop Museum belongs to this species ; specimens collected at Amauli, Tutuila Island, 5th Sept., 1923 (O. H. Swezey) ; and Fagasa, Tutuila Island, 8th Sept., 1923 (O. H. Swezey and G. P. Wilder).

This species is very closely allied to a New Britain species described elsewhere (Hill, Mem. Nat. Mus., Melb., No. 7), under the name *M. umbritarsus*, from which it differs in having smaller eyes and ocelli, smaller, paler, less setaceous and glabrous head and differently shaped pronotum.

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## EXPLANATION OF TEXT-FIGURES AND PLATE

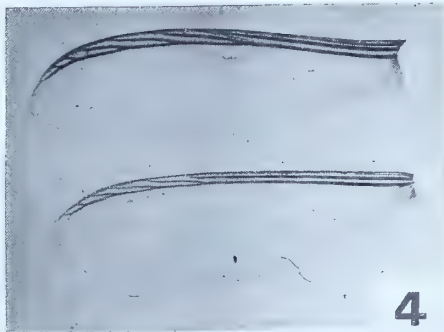
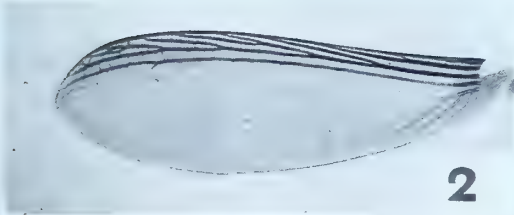
## TEXT-FIGURES

1. *Calotermes (Neotermes) samoanus* Holmgr. Imago—head.
2.     "         "         "         "         "         antenna.
3.     "         "         "         "         "         pronotum.
4.     "         "         "         "         "         Soldier—head.
5. *Calotermes (Calotermes) repandus*, n. sp. Imago—side of head.
6.     "         "         "         "         "         pronotum.
7.     "         "         "         "         "         Soldier—head.
8.     "         "         "         "         "         antenna.
9.     "         "         "         "         "         hind leg.
10. *Calotermes (Cryptotermes) buxtoni*, n. sp. Imago—antenna.
11.     "         "         "         "         "         mandibles.
12.     "         "         "         "         "         pronotum.
13.     "         "         "         "         "         Soldier—head and pronotum viewed obliquely from behind.
14.     "         "         "         "         "         head and pronotum in profile.

## PLATE I

- Fig. 1. *Calotermes (Neotermes) samoanus* Holmgr. Imago—thorax, legs and abdomen.
2.     "         "         "         "         "         forewing.
3. *Calotermes (Calotermes) repandus*, n. sp. Imago—thorax, legs and abdomen.
4.     "         "         "         "         "         wings.
5. *Microcerotermes peraffinis*, Silv.—termitarium.









## ODONATA

BY LT.-COL. F. C. FRASER, I.M.S., F.E.S.

(With 5 Text-figures)

IN 1866 Brauer published the description of a single species of dragonfly from Samoa, and in the following three years, descriptions of three others. These were the first Samoan dragonflies to be described, nothing further being published on them until a period of fifty-five years had elapsed. In the year 1924 the present author issued a preliminary note on Samoan dragonflies, in which were listed fifteen species, including three new to science. A further note was published at the beginning of last year (1926), in which another new species was described. Since the publication of the latter, much fresh material has been collected by Dr. J. S. Armstrong, Dr. P. A. Buxton, Mr. G. H. E. Hopkins, Mr. E. H. Bryan, and others, bringing the list up to twenty-nine species in all. This new material, consisting of about 300 specimens, includes representatives of four genera, twelve species not hitherto reported from the Samoan Islands, one undetermined species, and one new species from Tonga. In addition, the female of *Pacificagrion lachrymosa* has been discovered. The complete list of species is as follows.

Order : ODONATA.

Suborder : ZYGOPTERA.

Family : COENAGRIONIDAE.

1. *Pseudagrion samoensis* Fras.
2. *Agriocnemis exsudans* Selys.
3. *Agriocnemis vitiensis* Tillyard.
4. *Agriocnemis interrupta*, sp. nov.
5. *Pericnemis annulata* Brauer.
6. *Ischnura aurora* Brauer.
7. *Ischnura buxtoni*, sp. nov.
8. *Ischnura haemastigma*, sp. nov.
9. *Ischnura albistigma*, sp. nov.

10. *Ischnura chromostigma*, sp. nov.
11. *Amorphostigma armstrongi* Fras.
12. *Amorphostigma auricolor*, sp. nov.
13. *Pacificagrion lachrymosa* Fras.

Suborder : *ANISOPTERA*.

Family : *AESCHNIDAE*.

14. *Anax gibbosulus* Ramb.
15. *Anaciaeschna jaspidea* (Burm.).
16. *Gynacantha apiaensis*, sp. nov.
- 16A. [*Gynacantha stevensoni*, sp. nov., from Tonga.]

Family : *LIBELLULIDAE*.

17. *Hemicordulia pacifica* Fras.
18. *Hemicordulia assimilis oceanica* Selys.
19. *Hemicordulia cupricolor*, sp. nov.
- 19A. *Hemicordulia*, sp. ?
20. *Lathrecista asiatica asiatica* (Fabr.).
21. *Diplacodes bipunctata* (Brauer).
22. *Rhyothemis regia chalcopylon* (Brauer).
23. *Rhyothemis regia exul* Ris.
24. *Tramea limbata* (Desj.).
25. *Pantala flavescens* (Fabr.).
26. *Tholymis tillarga* (Fabr.).
27. *Macrodiplax cora* (Brauer).
28. *Orthetrum sabina* (Drury).

It will be noted, from a perusal of the above list, that the fauna presents some striking features. In the suborder Zygoptera, which is divided about equally into two large families, the first family, the Agrionidae, is entirely unrepresented. In the second, the Coenagrionidae, there is an extraordinary development of the group *Ischnura*, no fewer than eight out of the twelve species belonging to this genus or its relatives (*Amorphostigma*, *Pacificagrion*).

In the suborder Anisoptera, the families Gomphidae and Cordulegasteridae are completely wanting, while only three species of Aeschnidae have been discovered. In the remaining family, the Libellulidae, there is a marked



development of the genus *Hemicordulia*, an ancient stock from which the dominant subfamily Libellulinae probably originated. Species belonging to other genera are mostly those with strong migratory tendencies, and are related to Australia and South Asian forms.

### 1. *Pseudagrion samoensis* Fras. (Text-fig. 1, *a* and *b*).

*Trans. Ent. Soc. Lond.*, pp. 430-432, 1925.

The only representative of the genus in the islands, closely related to the Fijian *P. pacificum* Till. Many specimens collected by J. S. Armstrong, Siumu, Upolu Isl., 16-24.viii.22, 18-29.x.22, 16.xii.22 and 23.iii.23.

### 2. *Agriocnemis exsudans* Selys.

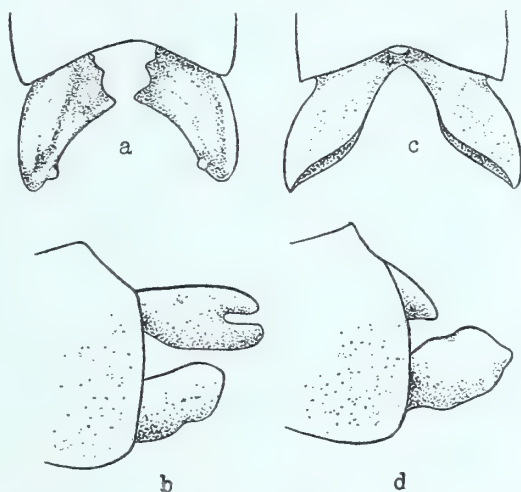
*Bull. Acad. Belg.* (2) xliii, p. 146, 1877; Tillyard, *Trans. Ent. Soc. Lond.*, 335-337, 1924; Fraser, *l.c.* p. 432, 1925.

Closely related to *A. pygmaea* and *A. vitiensis*, and probably of not more than subspecific rank. Found throughout the whole year at Apia, Upolu Isl.: specimens also examined from Savaii Isl., Pago Pago, Tutuila Isl., and Funafuti, Ellice Isl. In Upolu the species is common from sea-level to 2000 feet, near Malololelei.

### 3. *Agriocnemis vitiensis* Tillyard.

Tillyard, *l.c.* pp. 337, 338, 1924; Fraser, *l.c.* p. 432, 1925.

Several males and females collected by J. S. Armstrong, Apia, Upolu Isl., 28.x.-30.xi.23, in company with the foregoing species. I have not been able to satisfy myself as to the differences in the anal appendages pointed out by Tillyard. The main point of differentiation appears to be that the terminal segments of the abdomen remain reddish in this species, even in the very adult stage, whereas they turn blackish-brown in *exsudans*. Age differences, however, are very unreliable, when dealing with genera such as *Agriocnemis*, *Ischnura*



TEXT-FIG. 1.—*a*. Anal appendages of *Pseudagrion samoensis* seen from above. *b*. The same seen from the left, in profile. *c*. Anal appendages of *Agriocnemis interrupta*, sp. nov., seen from above. *d*. The same seen from the left, in profile.

and *Enallagma*, in all of which reddish colouring predominates in the teneral condition.

4. *Agriocnemis interrupta*, sp. nov. (Text-fig. 1, *c* and *d*).

The largest species of the genus yet discovered, its measurements surpassing all others by about 6 mm. in breadth and length. In this respect it approaches *Argiocnemis*, a closely related genus.

Male. Abdomen 26 mm. Hindwing 18 mm.

*Head*.—Labium white; labrum and epistome glossy metallic blue; cheeks and bases of mandibles blue; rest of head matt black, except for a large subtriangular blue postocular spot on each side behind the eyes.

Prothorax black on dorsum, bluish on sides, the posterior lobe of great length, narrow and grooved above longitudinally.

Thorax broadly black on dorsum, light blue on the sides, with a small black spot on the upper part of the postero-lateral suture. The dorsum marked with a broadly interrupted blue antehumeral stripe, represented by an upper triangular spot against the alar sinus and a narrow stripe below which tapers to a point and ends about halfway up the dorsum of thorax.

Legs short, robust, yellowish, with a broad black stripe on extensor surfaces of femora.

Wings palely enfumed, 11 postnodal nervures in forewing, 9 in the hind; arc distad of outer antenodal nervure in all wings; pterostigma pale brown, small, its outer edge somewhat rounded, the inner oblique.

Abdomen black on dorsum, bluish laterally, the apical end of segment 7, and the whole of segments 8–10 brick red. Segments 3–7 with short basal blue rings.

Anal appendages brick red, the superiors robust, stoutly built, divaricate, equal in length to segment 10, the apices notched. The inferiors broad at base, tapering rapidly to a fine point, directed very obliquely upward and almost hidden in the end of abdomen.

*Distribution*.—A single male from Malololelei, Upolu, W. Samoa, coll., J. S. Armstrong. Distinguished from other species of the genus by its large size (about 6 mm. larger in all directions). It belongs to the *pygmaea* group, as is shown by its metallic labrum.



5. *Pericnemis annulata* Brauer.

*Verh. zool.-bot. Ges. Wien*, xix, p. 10, 1869.

Not represented in the collections made by J. S. Armstrong and P. A. Buxton. The species is a doubtful one, and was entirely suppressed by Selys in his account of the genus published in 1877. The genus was placed by Selys in the 4th Legion *Platycnemis* in his *Synopsis des Agrionines*, published in 1863, but was subsequently removed to the 5th Legion *Agrion* in 1877 as a subgenus of *Telebasis*. It is quite possible that the species may turn out to be yet another of the Ischnurine group with abnormal pterostigma.

6. *Ischnura aurora* Brauer (Text-fig. 5, iv.).

*Agrion aurora* (*Ischnura aurora*) Brauer, *l.c.* xv, p. 510, 1865; *Reise d. Novara, Neur.*, p. 56, 1866; *Ischnura delicata* Selys, *Bull. Acad. Belg.* (2), xli, p. 281, 1876.

A common insect at Apia, Upolu Isl., and found from September to April. Also taken at Amauli, Tutuila, and Safune, Savaii; and at Funafuti, Ellice Group, during September. Of wide distribution, extending from Western India to Samoa, throughout South Asia, Australia and the Pacific Islands. Specimens from Samoa conform to Asiatic examples in having the abdomen yellow (Australian forms are red). In Coorg I have often watched this species taking flight after emerging, and have followed it with my eyes as it rose almost perpendicularly in the air, until finally lost to sight at a great height. Such a frail, tiny insect floats like a piece of gossamer, and is borne by the upper air currents to immense distances. In fact its very weakness becomes a source of strength, enabling it to spread over, and populate a vast area. I have noted swallows snapping up this insect during the natal flight, and *Orthetrum sabina* preys freely upon it in its reedy fastnesses.

7. *Ischnura buxtoni*, sp. nov. (Text-figs. 3, *a* and *b*; 5, v.).

Male. Abdomen 26–27 mm. Hindwing 16–17 mm.

*Head*.—Labium creamy white; labrum pale greeny-white, with its base finely black, this colour produced as a median short point; anteclypeus, the cheeks, and a transverse stripe on frons pale olive; above epistome black with a metallic lustre, rest of head matt black except for a postocular blue spot on each side behind, and a twin linear spot at middle of back of occiput.

Prothorax black on dorsum, the hinder border very finely and the lower part of sides broadly, as well as coxae and trochanters of anterior pair of legs, yellow.

Thorax with a pair of small yellow horns on its anterior border, projecting towards the posterior lobe of prothorax, the dorsal pair the largest. Dorsum of thorax broadly black, with a narrow antehumeral stripe on each side olive-green (probably blue in life). The stripe narrows gradually above and then expands again at its extreme upper end. Laterally bluish-green with a black stripe, incomplete below, on the postero-lateral suture. The dorsal black area, just posterior to the humeral suture, sends a hooked downward prolongation for a very short distance.

Legs yellow on flexor surface, broadly black on the extensor.

Wings hyaline, distinctly enfumed; postnodal nervures in forewing 11, in the hind 10; pterostigma slightly larger in the forewing, its inner side somewhat shorter than outer, that of forewing pulverulent white above in adults, that of the hind blackish-brown, all similarly coloured beneath.

Abdomen bluish-green, marked broadly with black on dorsum, and with blue on segments 8-10. Segment 1 with the whole of dorsum broadly black, its apical joint bluish-green, segment 2 similar but the black constricted by the blue ground colour at the apical border, and the apical joint black, segments 3-6 with the whole of dorsum black except for narrow basal blue rings. The black on these segments expanded subapically and then contracted at the apical border where it joins an apical black ring. Segment 7 very broadly black, its lower border yellowish; segment 8 with its apical half azure blue, this colour extending broadly as far as the base of segment on the sides; 9 and 10 entirely blue save for a small lateral black elongate spot on each side, the latter segment with a prominent blunt spine at the apical end of the dorsal carina.

Anal appendages black, the inferiors paler and brownish at base, superiors robust and stoutly built, shaped like the butt end of a revolver, constricted and cylindrical at base, then abruptly bent downward and thickened, bluntly pointed behind and below. The inferiors broad at base, rapidly tapering, thin and cylindrical, curving evenly up and back. Seen from below, these appendages are a little concave towards each other and their apices tend to approximate. The superiors show only as rounded, or thick conical, processes on either side of them.



Female. Abdomen 19–24 mm. Hindwing 15–18 mm.

*Head*.—Labium white ; labrum creamy yellow, its base black ; anteclypeus yellow ; postclypeus glossy black, an obscure bluish stripe between it and frons above, largely hidden by melanism ; rest of head black, especially in adults, but in the younger specimens there are postocular spots similar to those of the male.

Prothorax black on dorsum, yellowish low down on sides, this part more or less pulverulent white.

Thorax broadly black on dorsum with a narrow bluish-green ante-humeral stripe, largely obscured or almost obsolete in very adult specimens. Laterally bluish-green, with a broad black stripe on the postero-lateral suture. Sides and beneath more or less pulverulent white.

Legs reddish-brown, the extensor surface of femora black. The coxae, trochanters and inner surfaces of femora pulverulent white in adults.

Wings hyaline ; 12–14 postnodal nervures in forewing, 11 in the hind ; pterostigma small, light brown framed in black nervures.

Abdomen black, the ventro-lateral borders narrowly ochreous. Segment 1 and the basal half of 2 more or less pulverulent white. Segments 8–10 marked with blue, the extent of this colour varying with the age of specimens, and in two of the present collection quite obsolete. In the younger specimens, there is a broad triangular blue patch on segment 8, with its base against the apical border of segment, and its apex extending to within a short distance of the anterior margin ; on 9 a similar but more extensive marking, its base, at the apical border very broad, its apex narrowed and extended right up to, and broadly contiguous with, the base of segment. Segment 10 with its dorsum wholly blue from base to apex.

Vulvar scale ochreous, robust, extending to end of abdomen.

The 8th abdominal segment without a ventral spine in any of the seven females examined.

*Distribution*.—Two males and seven females, Malololelei, Upolu Isl., W. Samoa, 2,000 ft., 2.vii.24, coll. J. S. Armstrong. In general facies closely resembling *I. senegalensis* Ramb., a species extending from S. Africa to the Philippines.

8. *Ischnura haemastigma*, sp. nov. (Text-figs. 2, *a* and *b*; 5, vi.).

Male. Abdomen 24 mm. Hindwing 15.5 mm.

*Head*.—Lips, epistome and frons bright citron yellow; vertex black, marked with small round greenish postocular spots.

Prothorax black, with an anterior collar and the sides broadly citron yellow, Thorax black on dorsum, with the anterior hooklets yellow, small. Antehumeral stripes broken up into an upper small linear spot and a lower larger pyriform spot, both citron yellow, the dorsum otherwise broadly black, the sides citron yellow changing to reddish near the ventral surface, and marked with a narrow black stripe on the hind suture, and a small linear black point beneath the root of forewing.

Legs bright crimson, with fine black spines.

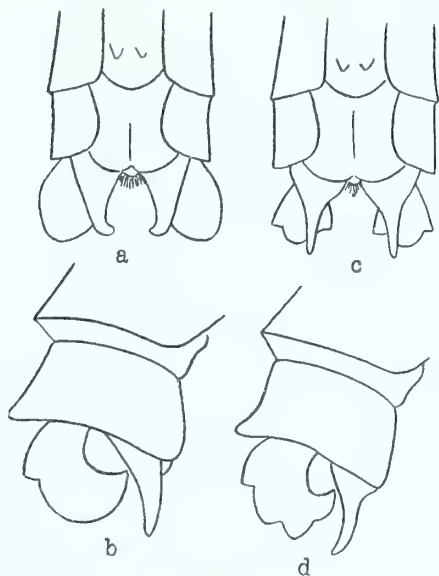
Wings hyaline, pterostigma in forewing blood-red, almost quadrate, the costal side shortest, the outer and inner sides oblique, the hinder a little rounded, over about one cell. In the hindwing, this structure is normal and about one-third the size of that of forewing, which is much enlarged. Postnodals in forewings 10–11, in the hind 9; *ac* lies a little nearer the distal antenodal.

Abdomen bronzed black, this colour forming complete broad apical rings on 3–7. Segments 1–7 yellow along the ventral

borders and beneath. Segment 8 with a blue triangular apical marking on its apical end, the base applied to the apical border of segment, segment 9 entirely blue, 10 with a large dorsal geminate spot of blue.

Anal appendages black, the superiors sickle-shaped in profile, about as long as segment 10, seen from above, rounded and hollowed out. Inferiors slightly longer, broad at base, tapering to a sharp point, which is turned rather sharply inward as seen from below.

*Distribution*.—A single male from Malololelei, Upolu Isl., 2,000 ft., P. A. Buxton, 5.xii.25. The colour of the pterostigma is unique in the genus, with



TEXT-FIG. 2.—*a*. Ventral view of anal appendages of *Ischnura haemastigma*. *b*. The same seen from the right side. *c*. Ventral view of anal appendages of *Amorphostigma armstrongi*. *d*. The same seen from the right side.



the exception of a new species, of which I have seen specimens from the Society Islands. In this latter the shape of the pterostigma is normal, though enlarged. The shape of the structure in the present species recalls that of *Protosticta*, and is very similar to that of *Ischnura perparva*, of N. America.

9. *Ischnura albistigma*, sp. nov. (Text-fig. 5, i.).

Male. Abdomen 25 mm. Hindwing 18 mm.

*Head*.—Labium creamy white; labrum greenish-yellow, with a small medial basal punctate spot black; epistome glossy black; postclypeus and frons greenish-yellow, including basal segments of antennae; vertex black, marked by small round azure-blue postocular spots.

Prothorax black. Thorax black on dorsum, the anterior hooklets, narrow antehumeral stripes, and the sides broadly greenish-yellow. The latter with a narrow black stripe on the hinder suture, and a small linear spot beneath the root of forewing.

Legs yellow, hind femora with a black outer stripe.

Wings hyaline. Pterostigma of forewing about three times the area of that of hind, pale creamy white, with its inner angle broadly black, giving an eye-like effect to the structure. Its outer side very oblique and elongate, its costal border longer still and, like the outer, framed in pale creamy white, so that the costa appears to be absent here. Inner and hinder borders very short and black, the latter slightly rounded. Pterostigma of hindwing normal, sepia framed in black, with a paler ring within. Postnodal index, 13–14 in the forewings, 10–11 in the hind; *ac* situated nearly midway between the two antenodals.

Abdomen citron yellow, marked broadly on the dorsum with enfumed ochreous and black, as follows: Segment 1 with a sub-quadrated black dorsal spot on a blue background, 2 with a broad thistle-head shaped spot on dorsum connected to an apical ring, segments 3–6 with broad dorsal stripes black at either end, warm reddish ochreous in between, the basal ends of the stripes not quite extending to the base of segments, where they leave narrow yellow rings. Segment 7 entirely black on the dorsum, 8 with a broad triangular blue spot on dorsum, the base of triangle applied to the apex of segment, 9 all blue save for a small sub-dorsal apical black spot on either side, 10 similar but the lateral black spot larger.

Anal appendages black. Superiors seen in profile shaped like the butt of

a revolver, seen from above rounded and with a robust outer spine. The inferiors of about the same length, and equal to the length of segment 10, broad at base, tapering to a fine point, widely divaricate.

Female unknown.

*Distribution*.—Only two specimens, both males, are known: the first, the type, came from the same locality as that of the foregoing species, and was taken on the same date, in the same deep ravine. The second is a teneral male, taken between sea-level and 300 ft. at Pago Pago, Tutuila Isl., 18.vi.23 (H. C. Kellers). The species is closely related by its appendages to others of the group as represented in Samoa, and especially to *A. armstrongi*, but distinguished easily from all others by the shape of its pterostigma. I have seen a Tahitian species, in which the pterostigma shows almost identical shape and colouring, but in which the anal appendages are almost identical with those of *I. haemastigma*.

#### 10. *Ischnura chromostigma*, sp. nov.

4 ♂ and 5 ♀, all from Pago Pago, Afone Trail, Tutuila Island, 10.ix.23 to 12.iv.24, col., E. H. Bryan, Swezey and Wilder. All specimens except a single female are imperfect, the terminal segments with anal appendages being absent.

Male. Abdomen 24 mm. (7 segments only). Hindwing 18–20 mm.

*Head*.—Labium yellow; labrum azure blue, its anterior border narrowly yellow, its base narrowly black, as also the epistome. A broad transverse greenish-blue stripe across frons extending from cheek to cheek and changing to yellowish-green low down on the cheeks and bases of mandibles. Rest of head matt black, marked with two rounded postocular blue spots.

Prothorax black, the sides yellow, as also coxae and trochanters.

Thorax black on dorsum, marked with two pale blue antehumeral stripes. Laterally blue, with a broad black stripe over the second lateral suture and anterior border of metepimeron. Anteriorly the blue area slightly overlaps the first lateral suture in its lower three-fourths.

Legs yellow, with black spines; the hinder and outer parts of all femora and the hinder surfaces of tibiae black.

Wings hyaline, 14 postnodals in forewings, 11 in the hind. Pterostigma differing in fore- and hind-wings, normal in the latter, where it covers less than



one cell, sepia in colour, its outer angle very acute. In some the costal border pale yellow. Pterostigma of forewing extremely narrow, nearly twice the length that of hind, its inner angle acute, its outer much more so and prolonged along the costa, so that the costal border is nearly half as long again as the posterior, and the outer border one-fourth as long again as inner; black, the portion of the costa bordering it and its costal border pale citron-yellow, as also the upper half of the outer border and a small part of the inner border.

Abdomen dark ochreous on dorsum, or pale yellow in younger specimens, laterally yellow. Segment 1 with a black dorsal quadrate spot and a lateral clouding of brown, 2 with a broad dorsal black band, abruptly constricted apicad and barely reaching the apical border, broadening sub-basally, 3-7 with both basal and apical ends black, this fading and blending imperceptibly into the dark ochreous of dorsum. In most specimens the dorsum is pale yellow with a basal and apical clouding of black, but this is due to immaturity. Remaining segments and anal appendages missing.

Female. Abdomen 27 mm. Hindwing 21 mm.

Very similar to the male, but darker and the ground colour more greenish. The postocular spots blue, the ground colour of thorax pale blue, changing to yellowish on the sides. In the one complete female, the abdomen, except beneath, is black; in others slightly immature, the abdomen closely resembles that of the male, but the second segment has a basal and an apical black ring instead of the complete dorsal thick stripe.

Pterostigma in both wings equal, pale brown framed in black nervures. A well-developed spine on the ventral aspect of segment 8.

Type male and co-type female in Bishop Museum, Honolulu. Closely related to *I. albistigma* but distinguished by shape of pterostigma in forewings of male.

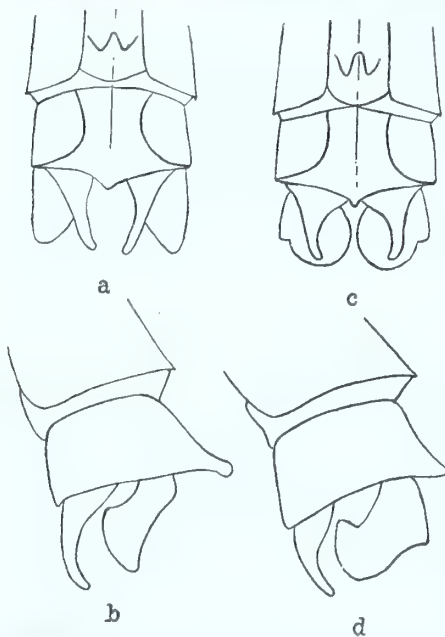
11. *Amorphostigma armstrongi* Fras., *l.c.* (Text-figs. 2, *c* and *d*; 5, vii.).

A large number of both sexes have been collected by Armstrong and Buxton since the types were first described. The former has taken the insects among sedges along the banks of Lake Lanuto'o, 1900 ft., and also along the banks of a stream flowing at the bottom of a deep gully near Malololelei, the sides of which are thickly covered with vegetation. The species also occurs commonly at or about sea-level, at Apia, and in other parts of Upola Isl., in taro swamps and

other places. E. H. Bryan took it at Salailua, Savaii Isl., 18.v.24, and Pago Pago, Tutuila Isl., 12.iv.24. Dates on which both sexes were taken at Malololelei, Upolu Isl., are as follows: 5.i.24, 13.iv.25, 25.iv.24, 4-19.vi.24, 31.xi.24, and 5.xii.25, from 2,000-2,300 ft.

Dr. Clarence H. Kennedy, of the University of Ohio, Columbus, Ohio, U.S.A., has kindly examined and reported on the penis of this species and of *Pacificagrion lachrymosa*, showing them to be typical of *Ischnura*. This confirms

my remarks as to their probable relationships, made in the Trans. Ent. Soc. Lond., *l.c.*, where I placed the genus *Amorphostigma* next to *Ischnura*.



TEXT-FIG. 3.—*a*. Anal appendages of *Ischnura buxtoni* seen from below. *b*. The same seen from the left side. *c*. Anal appendages of *Amorphostigma auricolor* seen from below. *d*. The same seen from the left side.

## 12. *Amorphostigma auricolor*, sp. nov.

(Text-figs. 3, *c* and *d*; 5, iii.).

Male. Abdomen 31 mm.

Hindwing 20.5 mm.

*Head*.—Labium dirty yellow; labrum bright orange, with its base narrowly glossy black; epistome reddish-brown, followed behind by a broad transverse stripe of violaceous on the frons, and including the front of the basal segments of the antennae. Rest of head matt black, except for a large round pale yellow postocular spot on each side (possibly blue during life).

Prothorax black on dorsum, the lower half of sides and the posterior border of posterior lobe very finely bright ochreous.

Thorax black on dorsum, with a bronzed reflex, marked with a narrow yellow antehumeral stripe. Laterally yellow with a broadish black line on the postero-lateral suture, and the vestige of another on the upper part of the first suture. On the anterior border of mesothorax are seen two small horns, one on either side, and partially hidden by the overhanging posterior lobe of prothorax.

Legs very robust, very short, bright ochreous with very short robust black spines (4-5 on hind femora).

Wings hyaline ; 11 postnodal nervures in forewing, 10 in the hind ; quadrangle of forewing with costal side half the length of the posterior, that of hind three-fifths the length ; arc at outer antenodal nervure in forewing, a little distad to it in the hind ; *ac* midway between the two antenodals and meeting *ab* a little distad of where the latter joins the hinder border of wing. Pterostigma of forewing made up of 2 cells, the outer of which appears to be the normal pterostigma, and is of the conventional lozenge shape ; the inner double the length of outer cell, and slightly narrower. The combined cells form a very elongate, narrow pterostigma which is rich opaque golden-yellow in colour, its anterior border brighter citron-yellow, including that part of the costa bordering it, the hinder and inner border black, the inner side very oblique, and forming an inner prolongation by fusion with the hinder nervure, which is clouded with black for some distance internal to the pterostigma. Finally the cell on the outer side of the pterostigma bears some slight traces of chitization of its membrane. Pterostigma of hindwing normal, lozenge-shaped and dark brown.

Abdomen ochreous to warm reddish-brown, the terminal segments marked with blue. Segment 1 with dorsum broadly black, this extended at base as a narrow ring completely encircling segment, segment 2 and base of 3 broadly black on dorsum, segments 3-6 with the apical ends diffusely black changing to brown towards the base, segment 7 very broadly black on dorsum throughout its whole length, 8 black at base, its apical third azure blue, this colour extending basad for a short distance on dorsum, 9 entirely blue save for a small lateral elongate basal spot of black extending for half the length of segment, 10 blue laterally and on dorsum with a sharply defined sub-dorsal stripe of black, which by meeting a fine apical bordering of black, encloses a transversely oval spot of blue on the dorsum.

Anal appendages black, about as long as segment 10, inferiors equal in length to superiors, broad at base, rapidly tapering, rather thin and cylindrical and ending in a blunt point. Seen from beneath, they are a little concave towards one another, their apices inclining slightly inwards ; viewed in profile, they slope gently down and back. Superiors much more robust, and of heavy cumbersome build, shaped like the hammer of a gun, at first directed straight back, a little constricted and cylindrical, then turned abruptly down towards the inferiors, the ends rounded, bulbous and glossy black. In profile, the extreme apex is seen to be turned in to form a short blunt point, directed towards the



anal end of abdomen. The 10th abdominal segment comes to a point at the apical end of the dorsal carina, but there is nothing like the bifid tubercle seen in *Ischnura*.

Female. Abdomen 29·5 mm. Hindwing 23·5 mm.

Differs rather widely from the male, the body also more robust.

*Head*.—Large, the postocular part enormously swollen and produced backwards as a large bulbous swelling on either side. Labium pale; labrum pale glossy yellow, cheeks and bases of mandibles pale greenish-yellow; face and frons light brown to olivaceous; rest of head black except for a pale blue postocular spot on each side.

Prothorax as in male, but pulverulent white laterally in one specimen. Thorax as in male, the sides more bluish and pulverulent at the lower part in adults, as also are the coxae and trochanters.

Legs yellow, rather darker than in the male. The femora with a macular stripe on the extensor surfaces.

Wings hyaline; 13–15 postnodal nervures in forewing, 12 in the hind; pterostigma normal in all wings over about 1 cell, dark brown, framed first in pale yellow and this again in thick black bordering nervures.

Abdomen robust, segments 1–7 marked as in male, but the black on dorsum more extensive on 3–6, and the ground colour more reddish-brown than ochreous. Segments 7–10 black; in one specimen with obscure blue markings on mid-dorsum of 8 and 9, and more clearly on apical border of segment 10. In the other female the blue markings better defined; 8 has an apical marking shaped like the ace of clubs, extending halfway to base, 9 has a similar marking but more extensive, the middle leaf of the club extending broadly up to base of segment. Segment 10 has the dorsum and sides broadly blue, and there is an elongate black lateral stripe separating the lateral from the dorsal blue. Segment 8, in the same specimen, has its apical and basal ends metallic green, and there are traces of this colour at the base of segment 9 also.

Vulvar scale ochreous, long and overlapping the end of abdomen.

*Distribution*.—Malololelei, Upolu, W. Samoa. Two males and two females, collected by J. S. Armstrong, 14–13.vii.25.

Distinguished from *A. armstrongi* by its much larger size, and by the pterostigma being bright golden-yellow instead of bright blue, and made up of two cells instead of four. The anal appendages also differ widely.

13. *Pacificagrion lachrymosa* Fras. (Text-fig. 5, viii.).

*Trans. Ent. Soc. Lond.*, pp. 505-507, Pl. XLIX, Feb. 1926.

Only the male of this interesting and freakish dragonfly has been described. Among the new material sent by Dr. Armstrong is a single female, which is remarkable for its large size, being quite the largest Coenagrionine yet discovered in the Samoan islands.

Female. Abdomen 31 mm. Hindwing 24 mm.

*Head*.—Labium yellowish-white; labrum blue, broadly bordered at base with glossy black; anteclypeus, cheeks and bases of mandibles blue; epistome glossy black. A broad dark olivaceous stripe traversing frons (possibly blue during life); rest of head matt black with an obscure dark reddish-brown marking at back. The postocular space not tumid as in *Amorphostigma*.

Prothorax broadly black on dorsum, bluish on the sides.

Thorax broadly matt black on dorsum, with a rather narrow yellow antehumeral stripe on either side (probably bluish-green during life), laterally yellow changing to bluish behind and below. A vestige of an upper black line on first lateral suture, and a fine black stripe on the postero-lateral suture.

Legs yellow, the middle and anterior pairs of femora and tibiae black on extensor surfaces, the posterior pair of femora dark brown on the same surface.

Wings hyaline; 15-16 postnodal nervures in forewing, 12-13 in the hind; petiolation beginning at the level of the basal antenodal nervure; venation rather close at the apices of wings, and occasional double nervures found in the costal space distad to pterostigma; the latter dark brown, that of forewing almost square, as long as broad, its inner and hinder borders equal, the costal border a little longer, the outer strongly rounded; that of hindwing much longer and narrower, *about twice as long as broad*.

Abdomen black, the sides of segment 1 blue, of 2-8 ochreous along the ventro-lateral border, and a spot of the same colour on the sides of 9. Narrow yellow rings at base of segments 3-6.

Anal appendages black, very short, conical, blunt.

Vulvar scale short, robust, not extending to end of abdomen. The apical border of segment 8 angulated below and ending in a blunt point not amounting to a spine (as seen in *Ischnura* sens. str.).

*Distribution*.—A single female from Malololelei, Upolu Isl., W. Samoa, coll. J. S. Armstrong, 26.vi.25. Distinguished from the female of *A. auricolor*,

which somewhat resembles it, by its larger size, by the angulation of the apical border of segment 8, by the pterostigma being different in fore- and hind-wings, by the absence of postocular spots, and of blue markings on the anal segments of abdomen. The angulation of the apical border of segment 8 may be taken as evidence of a rudimentary Ischnurine spine.

#### 14. *Anax gibbosulus* Ramb.

*Anax gibbosulus* Ramb., *Insec. Neur.*, p. 187, 1842; Brauer, *Reise d. Novara, Neur.*, p. 62, 1866; *Anax fumosus* Hag., *Verh. zool.-bot. Ges. Wien*, Bd. xvii, p. 42, 1867; etc.

I place here with some doubt, a single male from Lanuto'o Lake, 1900 ft., Upolu Isl., coll. J. S. Armstrong, 29.vi.24.

The marking on the frons is less extensive than in typical *A. gibbosulus*, and yet too extensive for *A. guttatus*. It is present as a basal line, with a thick prolongation forwards right up to crest of frons, where it spreads out for a short distance very finely on either side. The face is bright green, as also the thorax.

Abdominal segment 3 is more constricted than is usual in *A. guttatus*, and the orange markings of abdomen are distinctly smaller than in *A. guttatus* from India and Java, while segments 9 and 10 are quite unmarked.

The anal appendages are much broader and bulkier, especially near the base, than in *A. guttatus* from India.

The saffronated patch lying between the trigone and node in the hindwing is darker and more richly coloured than I have so far seen in Asiatic specimens belonging to the group, and there is a corresponding saffronated area in the forewing, which is absent in *A. guttatus*.

The specimen probably represents a local race of *A. gibbosulus* Ramb., but I believe that it would be possible to collect a series showing an uninterrupted passage from *A. guttatus* to *A. gibbosulus*, in which the present specimen would be one of the intermediary forms. The measurements are slightly larger than the average for *A. guttatus* from India.

#### 15. *Anaciaeschna jaspidea* Burm.

*Aeschna jaspidea* Burm., *Handb. Ent.* ii, p. 840, n. 16, 1839; *Anax jaspidea* Br., *Reise d. Novara, Neur.*, p. 63, 1866; *A. jaspidea* Hag., *Verh. zool.-bot. Ges. Wien*, Bd. xvii, p. 32, 1867; *Aeschna tahitensis* Br., *Verh. zool.-bot. Ges. Wien*, Bd. xv, p. 907, 1865; *Id. Reise d. Novara, Neur.*, p. 73, 1866; Hag. *l.c.* p. 48, 1867; etc.

A single female from Lotofaga, Upolu, W. Samoa, coll. J. S. Armstrong, 5.viii.24. Not differing from type in structure, but the wings are markedly



saffronated, far more so than in any specimen that I have seen from India or Malaysia. In the hindwing, the base, proximal to the trigone, is uncoloured, but from that level to as far as the apex of wing, the membrane is richly saffronated. In addition, both pairs of wings are enfumed, leaving occasional cell-middles clear here and there.

Another female from Apia, coll. P. A. Buxton, 13.x.24, came to light at night. In this the wings are clearer than in the first specimen, while its size is greater than that of specimens that I have seen from India and Java. *A. jaspidea* is often crepuscular in its habits, and this may account for this particular specimen coming to light; the failure to collect more examples may be ascribed to the same cause. In India I have obtained all my specimens by beating them up from reeds during daylight.

#### 16. *Gynacantha apiaensis*, sp. nov.

Male. Abdomen 47 mm. Anal superior appendages 7 mm., inferior 1.5 mm.  
Hindwing 46 mm.

*Head*.—Lips, face and frons dark reddish-brown, no marking on upper surface of frons.

Thorax dark purplish velvety brown, unmarked.

Legs light reddish-brown.

Wings, long and narrow, evenly and darkly enfumed throughout, many cell-middles paler, giving a stippled appearance; no basal markings; pterostigma rather long and narrow, over 4–5 cells, pale brown between black nervures; membrane white. Nodal index  $\frac{21-24}{24-19} | \frac{23-20}{19-23}$ ; anal triangle 3-celled; 4 rows of cells between *Rs* and *Rspl*; *Mii* and *Rs* slightly convex towards the costa; space between *Mi* and *Mii* with a long row of 2 cells in all wings.

Abdomen very dark reddish-brown, changing to blackish-brown on the terminal segments. Segment 3 markedly but not excessively constricted near its base, dilated thereafter and gradually tapering to the end. Orielllets moderately large, armed with 5 robust spines behind.

Anal appendages very long and slim, the inferior rather more than one-third the length of superiors, reddish-brown, darker towards the apex. Superiors a little sinuous, the outer border very shallowly concave to near apex, the inner border at first broadly convex, then shallowly concave and finally convex at apex, which ends on the outer side in a sharp point. The basal two-thirds

narrow and of even thickness, the apical third one-third broader. The inferior triangular, bluntly pointed.

*Distribution*.—Apia, W. Samoa, coll. J. S. Armstrong. A single male. The species is probably not uncommon, but being crepuscular is not often seen on the wing. Specimens of *Gynacantha* are usually secured by beating them up in the daytime from cane or clumps of bamboo.

#### 16A. *Gynacantha stvensoni*, sp. nov.

Male. Abdomen 53 mm. Appendages 7 mm. Hindwing 47 mm.

*Head* as in *G. apiaensis*, except that the frons bears a well-defined black T-shaped marking on its upper surface.

Thorax and legs coloured exactly as in *G. apiaensis*.

Wings evenly enfumed brown, but not so deeply as in *G. apiaensis*; nodal index  $\frac{19-24}{20-18} \mid \frac{24-18}{18-20}$ ; trigones with 7 cells in forewings, 5-7 in the hind; 7 cubital nervures in forewings, 6 in the hind; hypertrigones traversed 5-6 times in forewings, 4-5 in the hind; loop 10-celled; a single row of cells between  $Cu_1$  and  $Cu_2$  in hindwings; anal triangle 4-celled.

Abdomen dark reddish-brown, almost black on the hinder segments; segments 3-6 with dorsal linear spots bordering the apical side of the jugal sutures, 3 and 4 also with small sub-dorsal apical spots, all these markings gradually decreasing in size from segment 3 to segment 6.

Anal appendages blackish-brown, the inferior paler; the superiors long, narrow and straight for rather more than their basal two-thirds, inner and outer borders parallel. The apical ends slightly dilated, the extreme ends bevelled outwardly and ending in a fine point. Inferior appendage less than one-third the length of superiors, narrowly triangular, truncate.

Oreillets moderately large; 3rd segment markedly constricted near its base.

*Distribution*.—A single male from Nukualofa, Tonga, 17.ii.25, coll. G. H. E. Hopkins. Differs from *G. apiaensis* in the anal appendages, the inner border of the superiors in the latter being markedly sinuous and the apical third gradually dilated. There are several differences in the venation, mainly the single row of cells between  $Cu_1$  and  $Cu_2$  in the hindwings, the smaller anal loop and the lower nodal index.

Species of *Gynacantha* are very difficult to determine unless specimens are

actually compared; the present one most closely resembles *G. kirbyi* Karach, whereas *G. apiaensis* shows greater similarity to *G. dohrni*.

### 17. *Hemicordulia pacifica* Fras.

*L.c.* pp. 435, 436, 1925.

One pair from Pago Pago, Tutuila Isl., 14.xii.25, coll. P. A. Buxton, 3 males and 1 female from Apia, W. Samoa, coll. J. S. Armstrong, 16.x.23, 16.xii.23, 30.xii.23, and 25.iii.23. One female from Apia, 13.iv.24. One female, Vavau, Tonga, 8.iii.25, and one female Nukualofa, Tonga, 18.ii.25, G. H. E. Hopkins.

Owing to its small size and daintiness, this pretty insect, which is the smallest known *Hemicordulia*, is reminiscent of *Idionyx* or *Macromidia*.

### 18. *Hemicordulia assimilis oceanica* Selys.

*Bull. Acad. Belg.* (2), t. xxxi, p. 251, 1871; *Hemicordulia?* *assimilis* Selys, *l.c.* 1871; id. *ibid.* t. xxxvii, p. 18, 1874.

Judging from the number of specimens received, this species appears to be the dominant representative of its genus in the islands. The following are the data relating to the examples obtained: one female, Apia, W. Samoa, 13.iv.24; 2 females and 2 males, Lalomanu, Upolu Isl., 12 16.xi.24; 6 males, Mulifanua, Upolu Isl., 16.xi.24 and 9.xii.24; 3 males, Malololelei, Upolu Isl., 21.vi. to 2.vii.24; 6 females, Apia, 6.ix.24 and 27.x.24; one male, Tuaeufu, Upolu, 16.ix.23 (Swezey and Wilder). Its season appears to extend from April to December, and it possibly occurs throughout the year. An insect of wide distribution throughout Oceania: Dr. Buxton also secured a female from Teuma, Efate Isl., New Hebrides, 4.vii.25.

### 19. *Hemicordulia cupricolor*, sp. nov. (Text-fig. 4).

Male. Abdomen with appendages 34 mm. Hindwing 33 mm.

*Head*.—Labium cinereous; labrum brown, heavily bordered with black; face and lower part of frons dark olivaceous brown; frons above and upper part of front, and the vesicle metallic green; eyes emerald green; occiput dark brown; back of head and eyes black, with bronzed reflex.

Prothorax brown. Thorax of a beautiful uniform golden-green or coppery metallic, quite unmarked with paler or darker areas.

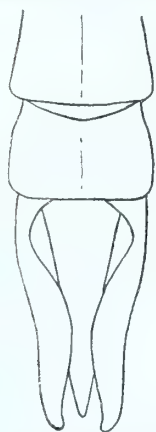
Legs long, the hind femora extending to the middle of 2nd abdominal seg-



ment, black, the middle and anterior pairs of femora reddish-brown; tibial keels extending the whole length of the hind tibiae, and for nearly the distal half of the anterior pair.

Wings hyaline; pterostigma very small, over about one cell, dark blackish-brown; nodal index  $\frac{8-9}{10-6} \bigg| \frac{9-10}{6-10}$ ; trigone of forewings traversed once; membrane pale brown; discoidal field of forewing with 2 to 3 rows of cells, rather irregular.

Abdomen dark metallic green-bronze from segments 3 to base of 9, segments 1 and 2 dark reddish-brown, the apical half of 9 and the whole of 10 black. Segments 3-8 with obscure lateral reddish-yellow markings, which, on segment 3, begin apicad to the jugal suture and run as a thick lateral stripe as far as apical border, on 4 and 5 a triangular basal spot continued as a narrow stripe along the ventral border, and on 6-8 as a mere baso-lateral spot.



TEXT-FIG. 4.—Anal appendages of *Hemacordulia cupricolor*, sp. nov., seen from above.

*Genitalia*.—Hamules very stout, projecting, pyriform, ending at the apex rather abruptly as a short, stout, backwardly curved spine; lamina flat and depressed; lobe narrow, tongue-like. Penis with a short, stout spine on dorsum.

Anal appendages black. The superiors, in profile, shallowly concave in the apical half, slightly convex upwards in the basal half, bluntly rounded at apex and rather sharply turned down at extreme base. Inferior nearly as long as superiors, curving very gently up throughout its whole length. Seen from above, the superiors are markedly constricted at base, dilating gradually and rather more so on the inner side than outer, then curved slightly out near apex and finally somewhat inwards. The appendages incline inwards towards each other, and the tips of superiors may touch. The inferior, from below, is narrow and triangular, tapering to a fine point, which at the extreme apex turns up rather abruptly. Superiors 3 mm. in length.

Female. Abdomen 34 mm. Hindwing 34 mm.

Body colouring exactly similar to that of the male. The yellow markings of abdomen absent on segment 3, narrower, but brighter and better defined.

The labrum dark yellowish-brown, the metallic green of the frons bordered below by a narrow bright ochreous stripe.

Wings enfumed, especially the hind and anterior part of apices of forewings ; nodal index  $\frac{7-9}{10-6} \bigg| \frac{8-6}{6-10}$ .

Vulvar scale broad and short, cleft to its base into two small equilateral triangular processes.

Anal appendages black, conical, pointed, as long as segment 9.

*Distribution*.—One pair from Malololelei, Upolu Isl., W. Samoa, 2.vii.24 ; 2 males, 14.vi.25, and 2 females 7.vi.25, from the same locality. One male from Mata Vanu, Savaii, 1000 ft., 22.xi.24. Two specimens from Savaii, 23.v.24 (E. H. Bryan), are rather larger than the type, and the nodal index is higher ; the forewing in both is broadly tinted with saffron at the apex. One female, captured on the wing at Malololelei, came to light about 300 ft. within a cave, 4.v.24. This incident is surprising, since the species of *Hemicordulia* are essentially sun-loving insects and by no means crepuscular in their habits. It is possible that this particular specimen was at rest within the cave.

#### 19A. *Hemicordulia*, species ?

One male, Tau Island, Manua group, 23.ii.26 (*A. F. Judd* in Bishop Museum, Honolulu).

In the absence of the five terminal segments of the abdomen, and of the anal appendages, I am not prepared to identify this specimen. However, it resembles *H. tau* Selys, and I do not think there can be much doubt of its identity. The upper frons and vesicle are a beautiful metallic blue, the thorax vivid metallic green ; in other details also it resembles *H. tau*.

#### 20. *Lathrecista asiatica asiatica* (Fabr.).

*Libellula asiatica* Fabr., *Ent. Syst. Suppl.*, p. 283, 1798.

Three males from Fagamalo, Savaii, 17.xii.25, and four males from Vailele Marsh, Apia, W. Samoa, 16.xii.23 and 2.ii.24, coll. P. A. Buxton and J. S. Armstrong. Four females, and one male, Nukualofa, Tonga, Feb. 1925 ; one Male, Vavau, Tonga, 4.iii.25, G. H. E. Hopkins. I refer these specimens to *L. asiatica* rather than to the sub-species *festu*, since they do not differ in any marked way from the typical form. The species ranges from India to Oceania.

21. *Diplacodes bipunctata* (Brauer).

*Libellula bipunctata* Brauer, *Reise d. Novara, Neur.*, p. 86, 1866; *Trithemis bipunctata* Kirby, *Cat. Odon.*, p. 18, 1890; etc.

A large number of this very common species was taken on Upolu, Tutuila, in the Ellice Isl., and at Vavau, Tonga. From the dates of capture, it is evident that a series of emergences take place throughout the year, since hardly a month failed to furnish its quota. The species is distributed throughout Australia and the Pacific Islands.

22. *Rhyothemis regia chalcoptilon* (Brauer).

*Celithemis chalcoptilon* Brauer, *Verh. zool.-bot. Ges. Wien*, Bd. xviii, p. 25, 1867; Kirby, *Cat. Odon.* p. 6, 1890 (*R. chalcoptilon*).

Curiously enough, neither Dr. Armstrong nor Dr. Buxton took or even saw this species, the type of which came from Samoa. There is a specimen in the British Museum collection labelled "Type," but this apparently merely refers to Kirby's type of *R. princeps*, a synonym of *R. chalcoptilon*. The species, which is found on several of the Pacific Islands, is characterised by the very extensive brown markings on both wings, obliterating almost the whole of the usual hyaline areas. [Is it not possible that the attribution of this species to Samoa rests on wrongly labelled material? Many of the earlier collectors in the Pacific made gross and frequent errors in locality labels.—P. A. Buxton.]

23. *Rhyothemis regia exul* Ris.

*Cat. Coll. de Selys (Libellulines)*.

Specimens were collected by Drs. Armstrong and Buxton on the following dates: Apia, 2 males, 24.iii.24; Pago Pago, Tutuila Isl., Samoa, 4 males and 1 female, 16.xi.24, 20.xi.24, 2.xii.24; one male, Apia, 14.vi.24, 3 males and 2 females, Upolu Isl., 14.xi.24, and 1 male, Apia, 4.ii.24. Specimens in the Bishop Museum, Honolulu, were collected 13.ix.23, Apia; 9.ix.23, Pago Pago. The species, in which the wing markings are intensely dark with a brilliant coppery reflex, appears to occur from November to April. The hyaline parts are saffronated, except for the clear apex in the wings of the female. The large spot over *Rspl* is variably confluent or detached from the apical marking, and in one female very broadly so and completely enclosing a hyaline spot. This is the first record of the occurrence of this species in the islands. The type is from the Kei Isls., near New Guinea.



24. *Tramea limbata* (Desj.).

*Libellula limbata* Desj., *Rapport. Soc. Maurice*, i, 1832; *Bull. Soc. Ent. France*, t. iv, p. 4, 1835; *Tramea limbata*, Kirb. *Trans. Zool. Soc. Lond.*, Vol. xii, pp. 318, 319, 1889; *Tramea samoensis* Brauer, *l.c.*, Bd. xvii, p. 22, 1867; *Tramea transmarina* id., *ibid.*, p. 21, 1867; etc.

Ten males and three females collected on the following dates: Aleipata, Upolu, April to May; Malololelei, Upolu, 2,000 ft., 14.vi.25; Apia, W. Samoa, 19-17.iii.23 and 16.xii.22. Also collected by Mr. Hopkins in Tonga, at Vavau, 8 and 9.iii.25, and Nukualofa, 20.ii.25.

Brauer's types of *T. samoensis* and *T. transmarina* were male and female of the same insect, and differ from the type of the species principally in the much smaller basal marking of the hindwing.

25. *Pantala flavescens* (Fabr.).

*Libellula flavescens*, Fabr., *Ent. Syst., Suppl.*, p. 285, 1798; *Pantala flavescens* Hagen, *Neur. N. Amer.*, p. 142, 1861; *Id. Stett. ent. Zeit.*, Bd. xxviii, p. 215, 1867; etc.

A cosmopolitan species, found throughout the world in tropical and sub-tropical areas. Many specimens received from Tutuila and Upolu, taken principally during September, when the species indulges in migration.\* Also collected at Vavau and Nukualofa, Tonga, Feb. and March, 1925, G. H. E. Hopkins. It is the dominant dragonfly of the world.

26. *Tholymis tillarga* (Fabr.).

*Libellula tillarga* Fabr., *l.c.*, p. 285, 1798; *Ramb. Ins. Nev.*, p. 39, 1842; Kirb., *l.c.*, pp. 258, 265, 1889, *Id. Cat. Odon.*, p. 1, 1890; etc.

Has a distribution nearly as extensive as the former species, but has not, so far, been taken in the New World, where it is represented by *T. citrina*. Hag.

Specimens of both sexes were taken by Dr. Armstrong on the same dates and in the same localities as *P. flavescens*. The wing markings are rather darker and better defined than usual.

27. *Macrodiplax cora* (Brauer).

*Diplax cora* Brauer, *l.c.*, Bd. xvii, p. 20, 1867; Kirb. *l.c.*, Vol. xii, pp. 261, 282, 1889; *Id. Cat. Odon.*, p. 23, 1890.

In Samoa, this species was only taken by Dr. Armstrong. It is apt to be mistaken for *Pantala* on the wing, which may explain why it was overlooked by other collectors. *Pantala*, *Tramea* and *Macrodiplax* are occasionally seen in flight together, and some discrimination is then necessary to tell which is

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\* I know nothing of these migrations, in Samoa.—P. A. Buxton.

which. Specimens of both sexes were taken at Apia, over marshes, 2-26.iii.23. One male collected at Vavau, Tonga, 5.iii.25, G. H. E. Hopkins.

### 28. *Orthetrum sabina* Drury.

*Libellula sabina* Drury, *Ill. Ex. Ent.*, i. t. 48, f. 4, 1773; Ramb. *Ins. Nevr.*, p. 47, 1842; *Orthetrum sabina* Kirb., *l.c.*, t. 55, f. 5, 1889; etc.

One pair from Apia, W. Samoa, coll. P. A. Buxton, 4.ii.24. Several collected in the same locality by J. S. Armstrong. A common species, extending from Africa, through Asia, to the Pacific Islands in tropical and sub-tropical areas. Samoa is, so far, its most eastern limit.

### ORIGIN OF THE ODONATAN FAUNA OF SAMOA

The whole of the Anisopterous species are immigrant, with the exception of two species of *Hemicordulia* and *Gynacantha apiaensis*. *Pantala flavescens* is cosmo-tropical, whilst *Orthetrum sabina*, extending from West Africa to Samoa, has a distribution almost as wide. *Lathrecista asiatica*, *Tramea limbata*, *Macrodiplax cora*, *Tholymis tillarga*, *Anax gibbosulus*, and *Anaciaeschna jaspidea* have all been found on islands far removed from continental masses, a clear proof of their migratory tendencies. *Rhyothemis regia exul* and its cousin *R. r. chalcoptylon*, along with *Diplacodes bipunctata*, are of nearer origin, the former coming from Papua and Australia, the latter from Australia; *R. r. chalcoptylon*, however, appears to be confined to the Pacific Islands, although intimately related to Papuan forms. *Lathrecista asiatica* is the most archaic of the Libellulines found in the islands, and probably originated in South Asia. *Hemicordulia* is also an old genus, and may well have originated in the ancient submerged Western Pacific continent. It has but a single representative in Asia, the remaining species occurring in Australia, Papua and the Pacific Islands, *H. cupricolor* being unknown outside Samoa, and *H. pacifica* being confined to Samoa and Tonga.

The three Aeschnidae are Austro-Malayan species, *A. jaspidea* especially having a wide distribution throughout the whole of South Asia, Papua, and thence far into the Pacific.

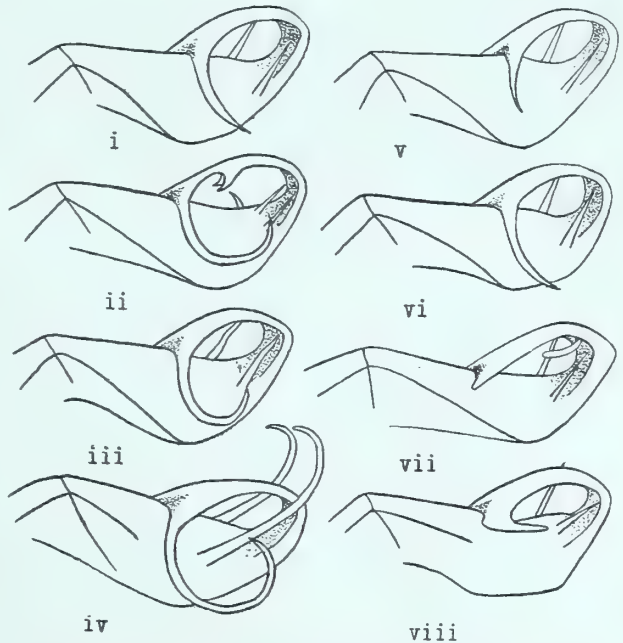
In striking contrast to what is found in the Anisoptera, the Zygoptera are almost entirely endemic. The few exceptions are *Agriocnemis exsudans*, known also to occur in New Caledonia, *Agriocnemis vitiensis* from Fiji, and *Ischnura*

*aurora*, a small wind-carried form widely distributed throughout South Asia, Australia and the Pacific Islands.

*Pseudagrion samoensis* is very closely related to *P. pacificum*, of Fiji, and the Australian *P. australasiae*. *Agriocnemis interrupta*, peculiar to Samoa, is probably of modern development; its chief characteristics are its large size and correlated increased density of venation. It is quite the largest known species of the genus, and in this respect forms a parallel to *Argiocnemis* of Southern Asia. From the metallic colouring of the upper lip, the red tint\* of the terminal segments of the abdomen and the shape of the anal appendages, it is clear that it is a descendant from the *pygmaea* group.

The remaining species constitute a group in themselves, and are of great interest in that they appear to represent the root of genus *Ischnura*. The group, which includes *Ischnura*, *Amorphostigma*, and

*Pacificagrion*, may be said to possess all the characters of genus *Ischnura* sens. str., save that the dorsal apical tubercle on segment 10 of the male, is not always present, and that the ventral spine on segment 8 of the female is invariably absent. I have examined a large number of species of *Ischnura* from Asia, Europe, Africa and America, and in none of them is the ventral spine ever absent. It is to be argued from this that the ventral spine is of modern development, for it is improbable that eight species,\* differing so widely as to require the creation of two new genera, should simultaneously lose such an important and useful organ. It may be argued that these species are not Ischnurine at all, but have



TEXT-FIG. 5.—Penes of : (i) *Ischnura albistigma*, sp. nov., (ii) *Ischnura senegalensis* Ramb., (iii) *Amorphostigma auricolor*, sp. nov., (iv) *Ischnura aurora* Brauer, (v) *Ischnura buxtoni*, sp. nov., (vi) *Ischnura haemastigma*, sp. nov., (vii) *Amorphostigma armstrongi* Fras., (viii) *Pacificagrion lachrymosa* Fras.

\* I.e. five in *Ischnura*, two in *Amorphostigma*, one in *Pacificagrion*.



developed along parallel lines. Against this we have the evidence of the penes, which, as shown in Fig. 5, are all typically Ischnurine in build. I have figured the penis of *I. senegalensis* (Fig. 5, ii.), a cosmopolitan species ranging from West Africa to the Philippines, and closely resembling *I. buxtoni* in appearance. It will be seen that the penes of this species and of *A. auricolor*, etc., are almost indistinguishable, although the insects are totally different in appearance and colouring.

The absence of the spine is sufficient evidence in itself to stamp the three Samoan genera *Amorphostigma*, *Pacificagrion* and *Ischnura* [without ventral spine] as distinctly archaic in nature, whilst the Ischnurine penis proves them to be the progenitors of the modern dominant genus. An analysis of the eight species shows that all agree in having the penis spined, the pterostigma of the forewing, in the male, differing from that of the hind, and lastly, the basal venation of wings Ischnurine in character. *Ischnura buxtoni* most nearly approaches modern forms, *I. albistigma* and *I. haemastigma* following on. *Pacificagrion* and the two species of *Amorphostigma* probably branched off at a very early date, developing generic characters of their own. On the evidence of the penis, and colouring of the insects, I am inclined to think that *A. armstrongi* is generically distinct from *A. auricolor*, the former being the more archaic. The colouring of *A. armstrongi* and *P. lachrymosa* is quite foreign to *Ischnura*, and paralleled in several archaic genera of the Protoneuridae.

#### EXPLANATION OF TEXT-FIGURES

- Fig. 1, *a*. Anal appendages of *Pseudagrion samoensis* Fras., from above.  
*b*. The same in profile.  
*c*. Anal appendages of *Agriocnemis interrupta*, sp. nov., from above.  
*d*. The same in profile.
- Fig. 2, *a*. Anal appendages of *Ischnura haemastigma*, sp. nov., from below.  
*b*. The same in profile.  
*c*. Anal appendages of *Amorphostigma armstrongi* Fras., from below.  
*d*. The same in profile.
- Fig. 3, *a*. Anal appendages of *Ischnura buxtoni*, sp. nov., from below.  
*b*. The same in profile.  
*c*. Anal appendages of *Amorphostigma auricolor*, sp. nov., from below.  
*d*. The same in profile.
- Fig. 4. Anal appendages of *Hemicordulia cupricolor*, sp. nov., from above.
- Fig. 5. Penes of : (i) *Ischnura albistigma*, sp. nov., (ii) *Ischnura senegalensis* Ramb., (iii) *Amorphostigma auricolor*, sp. nov., (iv) *Ischnura aurora* Brauer, (v) *Ischnura buxtoni*, sp. nov., (vi) *Ischnura haemastigma*, sp. nov., (vii) *Amorphostigma armstrongi* Fras., (viii) *Pacificagrion lachrymosa* Fras.





# INSECTS OF SAMOA AND OTHER SAMOAN TERRESTRIAL ARTHROPODA

## PROPOSED ARRANGEMENT :—

- Part** I. Orthoptera and Dermaptera.  
„ II. Hemiptera.  
„ III. Lepidoptera.  
„ IV. Coleoptera.  
„ V. Hymenoptera.  
„ VI. Diptera.  
„ VII. Other Orders of Insects.  
„ VIII. Terrestrial Arthropoda other than Insects.

The work will be published at intervals in the form of numbered fascicles. Although individual fascicles may contain contributions by more than one author, each fascicle will be so arranged as to form an integral portion of one or other of the Parts specified above.











